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1946

TRANSACTIONS

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DEGLUTITION AND THE TEETH.

By R. ERNEST RIX, L.R.C.P.(Lond.), M.R.C.S., L.D.S.(Eng.

An appreciation of muscular activities in the vicinity of the teeth and jaws should not be irrelevant to our common interests. I should like, therefore, to bring some aspects of deglutition to your notice. The subject is worthy, I think, of continued investigation and I would ask you to regard this address as an introduction to a neglected field of enquiry.

Our jaws and teeth make their contribution to the act of swallowing. Deglutition is a function of the first biological importance, and evolutionarily earlier than mastication. We must swallow food to live though we need not necessarily masticate it. Although this Society is primarily concerned with teeth and jaws as organs of mastication I am going to describe something of the part they play in helping us to swallow.

Let us assume that there is neither food nor drink to be swallowed and that deglutition is being performed merely to aid drainage of the naso-pharynx and to moisten and refresh the oral and pharyngeal mucous membranes. Such an act can be repeatedly witnessed in people engaged in conversation. It is initiated by voluntary effort, but when once started the process continues reflexly. It comprises a wondrously co-ordinated series of movements smoothly performed.

This act of swallowing unassociated with food or drink, one might call it the refreshing or basic swallow, is an act which can be modified when food or drink is being dealt with.

Since the wave of movement soon passes away from the neighbourhood of the jaws a description, a brief description, of the earlier movements is all that need concern us. The lips are brought together. The soft palate is raised and its upper and back wall becomes a tense sloping roof. The nasal cavity is closed posteriorly by the approximation of the walls of the naso-pharyngeal isthmus. There is a consequent momentary cessation of respiration. The lower teeth are brought up into occlusal contact with the uppers.

Now as these structures are thus preparing for the act of swallowing the tongue by the aid of its extrinsic and intrinsic muscles is spread and raised, and its front and sides sweep up the lingual surfaces of the occluded teeth and their supporting structures. The whole dorsum of the tongue comes to lie in contact with the palate. Posteriorly the dorsum forms a seal against the soft palate.

Then occurs a sudden and comparatively powerful contraction of the mylo-hyoids in the floor of the mouth which thrusts the spread tongue hard against the teeth and palate. Any saliva collected on the tongue is squeezed backwards through the isthmus of the fauces. For the purposes of this paper it is not intended to follow the wave of movements which proceed past this point.

I want to emphasize that the spread tongue, thrust with some force from below by the contracted mylo-hyoids, is operating in a rigid chamber formed at the sides and in front by the occluding teeth and their supporting bone. The chamber is roofed over by

the bony vault of the palate, and posteriorly by the tense, sloping soft palate. The tongue operates best in a rigid cavity, and it might be mentioned here that, with the occluded teeth providing the front and side walls, the lips and checks on the outside of the walls are not particularly active. There is no need for them to be.

It is necessary for these rigid boundaries to be remembered for it is hoped to show that in certain individuals there is an alteration of them when the basic act of swallowing is being performed.

When tough fibrous food is masticated and swallowed the actions already described take place with more vigour. The finely divided and ensalivated fraction is separated out and scooped up on to the dorsum of the tongue which becomes hollowed out for its reception, and periodically a powerful contraction of the mylo-hyoids acting on the spread tongue in its rigid chamber thrusts the bolus back through the fauces. That fraction of the food not yet sufficiently finely divided is meantime trapped and held partly by the occluding teeth, and partly by pressure of the front and sides of the tongue against the rugæ and the corrugations of the lingual surfaces of the occluding teeth. A little of it may be shut off in the buccal sulcus. The lips and the cheeks at the moment of swallowing are not in a particularly active state of contraction, though up to that moment they have been active in helping to guide and hold the food in position while it has been subjected to chewing.

An important though hidden modification in the position of the teeth occurs when juicy foods and soft prepared foods are swallowed. After a ripe pear, for instance, has been partially divided by the teeth the juice is sucked from it and swallowed with the upper and lower teeth separated. The tongue, in deglutition, on these occasions does not function within the usual cavity. Its periphery at the sides and the front comes in contact with the cheeks and lips where the remaining portions of pear will allow. Instead of the front and sides of the cavity being the occluded teeth, their place is taken by the lips and cheeks, the muscles of which are contracted to recreate a rigid though somewhat larger cavity in which the tongue may act efficiently. This " teeth apart " modification of the basic swallowing act is frequently evoked during the course of a meal as foods of a juicy or soft character are taken.

To return to the basic swallow itself there are children who invariably perform this act differently to the one already described. There are probably several variations, but I will describe one that occurs frequently. It is really similar to the modification of the basic act which is used for the swallowing of juicy and soft prepared foods.

The essence of the difference between the normal basic swallow and the particular atypical swallow I hope to demonstrate to you is that the teeth are not placed in occlusion. The spread and thrust of the tongue take its periphery through the separated teeth until it comes into contact with the cheeks and lips. To go some way towards creating a firm walled cavity for the tongue to act in, the muscles of the lips and cheeks are put in tension. With a little practice one can tell whether the teeth are closed or separated during an act of swallowing by watching for the increased activity of the lips which is demanded when the teeth are held apart. One may have read in orthodontic text books of the habit which some

children exhibit of contracting their mentalis muscle, causing a dimpling of the chin and some pursing of the lower lip. The books state that irregularities in the lower incisor region are associated with it. It is, I think, really a symptom of an abnormal act of swallowing and should not be regarded as a separate and troublesome trick, for I have not seen it except in association with an atypical swallow. Among the ways of overcoming it I have read of muscle exercises and of an operation to cut the nerve supply.

Those children who perform their basic act of swallowing in this atypical way never put their teeth together in the act of deglutition either at meal times or other times. There is not an easy alternation between the " teeth shut " and " teeth open " methods according to the character of the food being swallowed. They just persist in the " teeth open " method throughout. In fact it is difficult for them, even with a conscious effort, to swallow with the teeth together.

In contrasting these two types of deglutition it would be fair to say that the direction and intensity of the forces operating upon the jaws and dental arches are considerably different. In the normal the direction is mainly from within outwards, a centrifugal pressure of the tongue against the jaws and teeth. In the atypical the thrust of the tongue is in part uselessly spent, and a centripetal pressure of the lips and cheeks comes into play. Deglutition is so frequently performed that there might be some justification for wondering whether a variation from the normal would have an effect on the shape of the jaws and arches.

My attention was first drawn to the possible importance of the act of swallowing many years ago when I was reviewing a case undergoing treatment which was responding poorly and causing anxiety. I found that the basic swallow was performed with the teeth apart. This led to an inquiry into the act of swallowing in all cases seeking orthodontic treatment. I was surprised to find that, in a run of 86 children applying for orthodontic treatment at Guy's Hospital at the time, as many as 51 habitually separated their teeth when swallowing.

Through the good offices of Mr. J. F. Pilbeam, to whom I should like to tender my thanks, I was able to examine in January, 1945 an unselected group of school children between the ages of 7 and 11¾. An appraisal was made of the dentition of each child, and the way in which the basic swallow was performed was ascertained immediately afterwards. Before giving any figures I should explain that the standard set to assess the morphological perfection of the dentition of the children was not of prime importance to the investigation provided it was a constant one. I set a fairly high standard and it was as constant as one pair of eyes could make it. Developmental shortcomings recorded did not necessarily mean malocclusion worthy of treatment, and I tried to discount errors due to the accident of extracted teeth.

Variations in the Mode of Swallowing in a Group of 93 School Children.

A.	With teeth in occlusion	61
B.	With all teeth separated	27
C.	With cheek teeth in occlusion and with tongue spreading through separated incisors	3

D.	With incisors together and with sides of tongue spreading through separated cheek teeth	1
E.	Not ascertained	1
	Total	93

Examination of the dental condition of the children in Groups A.B.C.D. revealed the following :—

A. Among the 61 children there were 22 whose dentitions deviated from normal—36%.
B. Among the 27 children there were 22 whose dentitions deviated from normal—81%.
C. Among the 3 children there were 3 with anterior open bite.
D. The one child had pre-normal occlusion.

Comparing the percentage of maldevelopment in A and B the figures show that it is more than doubled among the swallowers with the teeth separated. This increase is, I think, great enough both to discount any error in observation or judgment on the part of the investigator, and to point to an association of some sort between the mode of swallowing and the shape of the jaws and arches.

An analysis of the 22 cases of maldevelopment in B (those swallowing with teeth separated) gave the following conditions :—

11 had small upper arches with 7 of them in linguo-occlusion on one side (6 on the left and 1 on the right.)
6 had small upper and lower arches.
5 had good sized upper and lower arches.

Grouping them according to their arch relationship in the antero-posterior direction there were :—

17 correct mesio-distally.
3 post-normal.
2 pre-normal.

The most frequent abnormality to appear was the small upper arch (in 50%) the next were the small upper and lower arches (in 27%). The vaults of the palate were high more often than not.

The frequent conditions were similar to the ones which are commonly ascribed to adenoids or mouth breathing.

Atypical swallowers are interesting in very many respects. Their mothers frequently complain that they tend to bolt their food, and I am inclined to think it is a correct observation, for the trapping of that part of the food, which is not yet ready to be swallowed, is not efficiently performed with the teeth apart. Those of you who heard Mr. T. B. Layton's unusual and interesting talk upon " Mastication as a Therapeutic Measure " will remember him touching upon the so-called " chewing eaters " and " gulping eaters." I think you will find that the " gulping eaters " are wrong swallowers.

Another point of interest I met with among the atypical was an occasional difficulty in pronouncing their sibilants. Whenever I have heard a lisp I have also found an atypical swallow.

Then again it is the wrong swallowers who tend to have the less clean mouths and teeth. The self cleansing action of the mouth is impaired if the basic swallow is not performed by the tongue

acting within the occluded teeth. It is a difficult point to demonstrate in the very young for it requires a considerable disturbance to upset the self cleansing process in early life. I can remember one particular instance of a child of 3 years, who had been eating some chocolate cake, going to its mother to ask her to remove a smear of cake which remained in the vault of the palate and which its atypical swallowing movements could not dislodge. With increasing years it becomes easier to demonstrate. If any of you have an adult patient who, despite regular scaling and polishing and despite protestations that the teeth are carefully cleaned, presents himself invariably with a caseous deposit at the necks of the teeth and along the gum margins you will find I think that he does not swallow with his teeth together. The most detergent swallow is performed with the teeth together.

To me the most significant association is an early departure from normal of the upper respiratory passages. One constantly gets histories of early colds, catarrh, snuffles, sore throats, snoring and earache. Many a little later have had tonsils and adenoids removed. By the time I see them these earlier troubles may or may not have disappeared. With the disappearance of these symptoms the wrong swallow still goes on. I do not know how long the wrong swallow is likely to persist. It seems often to go on at least as long as the masticatory apparatus is developing and it is seen, as I have already inferred, in the adult. I have seen one or two children who were possibly in the process of changing over to the normal swallow for they seemed to perform the basic act with equal ease with the teeth together and with the teeth apart. With nature's remarkable way of ever striving for economy of effort I could almost convince myself that before very long these few children would be swallowing normally. I should say, however, that it is most unlikely for the swallow to become normal while the naso-pharyngeal mucosa is still unhealthy.

Naturally one wonders why there is this failure to put the teeth together during the basic act. I know how devastating theories can look in black and white after some years of further investigation, but without some groping in the dark one cannot stimulate further enquiry.

Sillman has shown that the gum pads in the infant are not in contact at any point when the mandible is at rest. If one looks at a lateral X-ray of an infant's jaws, one is surprised to see how far apart they are. The babies look as though they have been X-rayed in the act of yawning. Look at any lateral X-ray taken at rest before about 2 years of age and you will see a wide separation. Broadbent's X-rays show it, and so do Symington and Rankin's "Atlas of Skiagrams" of thirty years ago. The erupting teeth and deepening alveolus gradually lessen this wide intermaxillary space until, if you study Broadbent's tracings, occlusion is restfully reached at $2\frac{1}{2}$ years. But in the suckling baby I do not think the gum pads are brought together at *any* time. If you press up firmly on a baby's chin you can force the jaws into contact, but you surprise yourself with the senile, "nutcracker" expression that you suddenly produce. It is an expression never produced by the baby itself not even when it is swallowing. In other words the infantile swallow does not entail a closed jaw motion. The tongue

spreads between the parted jaws. The swallowing of milk in any event requires the jaws to be apart. Now this is the very action so frequently seen in older children with an atypical swallow. These older children, despite the great increase in the vertical depth of their jaws and their erupting permanent teeth with the consequent filling up, as it were, of their intermaxillary space, have not outgrown their infantile swallow. There must be a time when it is normally outgrown. Broadbent maintains that centric occlusion is not reached until about $2\frac{1}{2}$ years, and it might be at about that time that the adult way of swallowing is usually acquired. I am trying to arrange to have a series of children of this age screened to clear up the point. So far I believe that that is about the age.

In view of the frequency with which the atypical swallow is associated with very early troubles of the upper respiratory spaces a direct casual relationship may exist. An unhealthy naso-pharynx may foster the infantile swallow. I have no doubt that in a child of, say, 8 years who has suffered from a long standing and real nasal obstruction you will find that the swallow is atypical and I suggest that the infantile swallow is overstaying its normal period. When the adult way of swallowing fails to develop at the usual age the infantile swallow usually persists with distressing obstinacy even if the naso-pharynx has become free from trouble in the meantime.

The oto-rhino-laryngologists will probably be able to suggest a reason why an unhealthy naso-pharynx produces the swallow with the teeth apart. It may be just a question of comfort. If you nip your nose and swallow with the teeth together unequal air pressures are created at each side of the tympanic membrane which are uncomfortable. During periods of intermittent nasal obstruction similar discomfort would be produced in children. Catarrh of the eustachian tubes too can produce conditions unfavourable to the equalisation of pressure upon the tympanic membrane. With the jaws separated there is an increased chance of the air pressures being kept equal, and especially during deglutition is discomfort avoided if the teeth are held apart.

If the main trend of these views can be accepted several problems can be clarified. It would allow us to throw some light on the uneasy association between adenoids and tonsils and small jaws. An abnormal naso-pharyngeal mucosa may lead to the " teeth apart " swallow, to developmental defects and to a chronic hypertrophy of lymphoid tissue, but if it did not lead on to adenoids and tonsils it could still produce an atypical swallow and developmental defects. One can thus appreciate why one sees small arches in children who apparently have no present troubles with throat and nose.

Again it helps us to appreciate why those children who present the condition in varying degrees of " status catarrhalis "—a phrase coined by Dr. H. C. Cameron—are often a cause of worry to orthodontists. " They carry with them into later childhood the infantile susceptibility to catarrhal infections." Our recent Secretary Mr. R. Cutler wrote a paper before this Society about them in 1931. Their facility for developing early troubles of the naso-pharynx often leads to a persistence of the infantile swallow with developmental defects gradually appearing and, what is more, a marked obstinacy to respond satisfactorily to orthodontic treatment.

It affords a more acceptable reason for the benefits upon bone growth which are credited to the chewing of tough food than is current at the moment. It is not so much the muscular vigour demanded as the type of deglutition evoked which is beneficial. In this connection one may add that dry foods evoke the " teeth together " swallow and wet foods the " teeth apart " swallow.

It fits in with our belief that many growth defects have an early origin, for it dates an important aberration of a normal function to the time when the deciduous dentition is becoming established. Rogers describes an exercise which he found of benefit to all his cases of malocclusion. It is the masseter-temporal-tongue exercise. The masseters and temporals are tightened ; in other words the teeth are clenched, and at the same time the tongue is forced against the teeth and alveolar processes. You will at once recognise this as the very exercise which you perform every time you swallow anything but soft foods or drink, and it is what many a child *never* has had the advantage of during its growth years.

In closing I should like to stress that I am very aware that much more work upon the subject is necessary. The shape of the jaws may well be impressed upon them in part by their muscular environment and I have demonstrated an important and enduring alteration in that environment.

* * *

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* * *

DISCUSSION.

Mr. R. Cutler, in proposing a vote of thanks to the President for his Address, said that it was not usual to discuss the Presidential Address and he thought it might be well to adhere to that practice on the present occasion, because the subject matter was entirely novel and the Address was in many ways complete in itself. It would merit further consideration when it was published in *The Dental Record*. Another paper of the same type would be read in December, by which time the members would doubtless have formulated their views upon the subject, and the President might have further information to give them upon it.

It usually fell to a very distinguished or a very senior member of the Society to propose the vote of thanks to the President for his Address. He himself was neither, but he had the distinction of having known Mr. Rix for over twenty years and having worked with him in his early days at Guy's Hosiptal. He knew very well the extraordinarily good work which Mr. Rix was doing at that hospital and had done there under very difficult conditions, with his ardent assistant, Mr. Kenneth Pringle.

One result of the ravages of the first world war was a great lack of men at the present time in the middle years of life, who formed a link between the senior and the junior members of the Society, and Mr. Rix, who came into that age group, would be a source of strength to the Society for many years to come. He also covered a very wide knowledge with that ingenuous diffidence which caused so much confusion to this country's gallant allies of the East and of the West. A great deal had been heard from Moscow about the decadent plutocracies, but when the first atomic bomb was dropped the Russians decided to think again. Mr. Rix had a great wealth of knowledge which he would doubtless disseminate, during his year of office as President, in his comments on the speakers' efforts at the meetings of the Society. Personally he was quite sure that the members would have a very happy year under the tutelage of Mr. Rix.

Mr. H. G. Watkin, in seconding the motion, said that he had known Mr. Rix and his work for many years and he was quite sure that the Society was very fortunate in having Mr. Rix for its President.

The subject dealt with in the Presidential Address was a most important one, and he thought that in the next two or three years a great deal more would be heard about swallowing and the action of the tongue, particularly in cases of open bite.

The vote of thanks was carried with acclamation.

The President, in responding, said he would do his best to uphold the dignity of his office and to help to further orthodontic knowledge. The meeting then terminated.

Mr. RIX emphasized the important aspects of deglutition by the showing of an excellent film.

* * *

FACIAL GROWTH IN CHILDREN

By G. G. CAMPION, L.D.S.(Eng.)

IN 1932, THERE WAS PUBLISHED by the Stationery Office a very important Report, (1) on facial growth in children, which opens a new chapter for orthodontists in the history of their subject, and may well lead to the entire regrouping of our knowledge of the subject itself.

In the preface to the Report it is stated :—" *in devising suitable methods of preventive treatment, dental practitioners would be greatly assisted if they were able, by means of accurate measurement, to identify the various types of abnormality in their early stages. Even in cases of pronounced malformation, accurate measurements would help in the precise diagnosis of the condition present. For these purposes it is obviously a necessary preliminary that exact information should be available as to the direct rate of normal growth of the jaws, and as to the normal correlations between different measurements. Without this knowledge there can be no sound basis for the identification of given abnormal conditions.*"

The Report in question set out in tables a long series of facial measurements recorded by Miss K. C. Smyth, and a statistical analysis of these by Dr. Matthew Young, a member of the Medical Research Council's Scientific Staff.

More than a word is needed to explain the nicety and exactness of the method according to which the observed and tabulated data were selected and measured.

A goodly collection of seemingly normal jaws and dental arches could be aggregated from museums but such a collection would lack the significance of race tradition and the necessary data of individual ages which must be exactly known for every skull, where a number are to be correlated in any careful study of growth. If these preliminary considerations be admitted—and it is indeed obvious that they are implicit both in the preface to the Report, and its final paragraph where it is expressly stated :—" *It is hoped that by the use of similar methods it may be possible to show exactly in what respects and to what extent typical abnormal forms differ from the normal at different stages of growth, and thus to indicate how preventive treatment may be most successfully applied.*"

It would seem then that we are driven back on measurement of the living face, for the data necessary to correlate abnormality with the age of its first appearance and maturation, and to acquire the requisite knowledge for the early preventive treatment of irregularities of the various kinds which confront an ordinary dentist in the routine of his professional life.

It is commonplace to state that the face consists of a bony frame or scaffolding over which a curtain of soft living and contractile tissue is loosely hung. Yet it is on the fixed and adjustable relations of these diverse and variable elements to one another that the material contributions to what we call the beauty of the human face are largely due. It seems that any measurement of the human face must begin with its bony structure and this scaffolding is fortunately possessed of certain salient points between which measurement is easy.

The studies contained in the Report on facial growth are based on measurements between these salient points and the whole report bears witness to the care in selecting the normal face, and exactness in measuring the distances between whatever salient points may have been chosen as a basis for the whole study. There is no mixture here of living faces and museum specimens : all the measurements are from living children of ascertained age groups arranged in one year periods of growth. This allows abnormal conditions to be compared point by point with ones of the same age which have been stringently selected, that is, as possessing normal faces with well developed and symmetrical dental arches closing together in what we are accustomed to call " normal " occlusion and in using the data in the report for a standard of normality the comparisons will always be between normal and abnormal faces of identical age periods of growth.

When we use the term " standard of normality " it is necessary to realise fully the limitations involved in this phrase ! *As used it applies only to the " selected " children who were all reared within the area of Greater London.* We fully realise that in " selecting " certain cases from the whole number examined and calling these stringently selected cases as pre-eminently " normal " we are, in this usage, sinning against one of the accepted canons of anthropometrical science. This, however, is owing to what is for us, a double necessity, the necessity (1) of including only arches which are of symmetrical shape, and (2) which conform also to the dentist's conception of what he has come, in the course of many decades, to call normal occlusion.

This report, then, since it is based on most stringently selected cases of normal occlusion (cases possessing, always, symmetrical and regular dental arches which when closed together meet in what a dentist would call normal occlusion), has created a standard of normality in the arches, consisting of age groups of one year from 8 and 9 to 12 and 13. In these age period groups of measured facial characteristics we shall possess the data for forming handy tables for use at the chair side at the actual time of making the facial measurements. This will afford the amplest opportunities for detailed comparison of normal and abnormal faces and arches in all the various facial characteristics. The measurements will always be used in comparison of normal and abnormal faces of identical age periods of growth, and it has to be repeated again and again that the " selected " children are those who have been selected as having normal faces with normal arches in normal occlusion. The " unselected " ones are the ones which have been ruled out from measurement by the stringency of the tests for symmetry and regularity of formation or for lack of what is usually called " normal occlusion."

Certain specific and salient points should be constantly borne in mind. The growth of the chin, for example, is often relatively slow compared with neighbouring parts of the face. This is a point of major importance which should be constantly borne in mind when recording features whose maturity is not completed for years so that any measurement or visual appearance has to be cautiously regarded as a condition which may pass away, giving place by continued growth, to features which will express perhaps more completely

known hereditary characteristics. The so-called " Hapsburg Jaw " is a case in point. When one member of this family was only in his boyhood, remarks were made to the effect that he did not possess the characteristic family jaw and that his legitimacy might be questioned on that ground. At a later stage of growth the family and hereditary characteristic of the mandible duly appeared and the previously questionable legitimacy was heard of no more.

The slow development of the chin may be seen in the growth records in this Report and the amount of its growth at different age periods noted from the figures. But the growth figures are insufficient. They need to be made objective by serial photographs of the same face taken at intervals to show in the actual faces the different stages of growth to 13 years, and even considerably later.

The record of such growth in the mandible is to be found in the measurements T.A. (Transmeatal Axis) to M.P. (Mental Point) on page 24 of the Report. It will prove interesting to take these in detail to show the periods of relative rest and relative growth in the chin from 8 to 13 years.

Measurements Transmeatal Axis to Mental Point.

Boys.			*Age*	*Girls.*		
Growth of Mandible.				Growth of Mandible.		
From	97.59			From	96.25	
to	101.19	3.60	8—9	to	98.03	1.78
From	101.19			From	98.03	
to	101.92	0.73	9—10	to	99.61	1.58
From	101.92			From	99.61	
to	103.02	1.10	10—11	to	101.54	1.93
From	103.02			From	101.54	
to	104.95	1.93	11—12	to	103.54	2.0
From	104.95			From	103.54	
to	108.82	3.87	12—13	to.	107.35	3.81
		11.23				11.10

The measurements are in millimetres.

Both for boys and girls it is apparent that there are periods of more active growth at 8—9 and 12—13 and of less active growth in the intermediate periods. In looking at these figures it is well to remember the numbers represent no isolated cases but the means or averages of perhaps fifty, sixty, or seventy-five individuals of that precise age, all of them " selected " for a normal face, normal arches and normal occlusion.

In starting, by a series of measurements, an investigation into facial abnormalities, it is essential for exact comparison of abnormal with normal cases that the various data which are to be compared should be in such form that immediate reference and comparison can be made from normal to abnormal in each one of the twenty characteristics which have been measured in the normal faces and arches. Only by such comparison in detail can exact judgment be formed of the precise positions and amounts of normal growth as found in varying and consecutive one-year-age periods ; when we have arranged the figures in these reports so that comparison in detail may be made rapidly and conveniently, we shall have reached a position of which some of us have long dreamed. We shall then, very truthfully and realistically, be able to say that we have trans-

muted Miss Smyth's data of normal growth into test data for the abnormal, or that the growth data of the report (all of them from stringently selected normal cases) have been transmuted into valid diagnostic data for the abnormal.

But are they not even more than this ? May we not also regard these figures as likely to be of real use in prognosis ? We are able to show some photographs of a face which seem to support this view. The child shown in Fig. 1 had at the age of 9 years 11 months ill-development of the maxillæ, the mandible being only 90 mms. measured from the transmeatal axis to the mental point, instead of 99.61 mms., the norm in the Report of this facial character in her age group. By a happy chance this girl was, in 1945, stationed on war work in Bramhall and thinking that I should be interested to see the improved condition of her face she presented herself one day, quite unexpectedly at my house, to allow me to see the development which had taken place. My treatment of the condition shown in Fig. 2 had been simply to expand the upper arch and pull in one of the upper centrals which was too prominent. Natural growth did the rest and when her face was again measured at her present age of 24 years and 5 months her mandible had grown to show a measurement from transmeatal axis to mental point of 109.5 mms., an increase of 19.5 over the original one. This growth had entirely reformed the facial contour, and from first to last no intermaxillary traction had been used.

Owing to the kindness of this lady, I am able to present for your inspection a juxtaposition of photographs at age 24 years and 5 months which illustrates in this case the variabilities one always comes across in any anthropological investigation of this kind.

Fig. 1

In Fig. 1 (initial stage 9 years and 11 months) the position of the Frankfurt Plane has been indicated, and the lack of growth in the mandible is very apparent for a child of this age.

Figs. 2 and 3 present different aspects of the same face all at

Fig. 2

the age of 25 years, to make clear that the apparent improvement is really due to growth and not to adroit movement of the face when being photographed.

Fig. 3

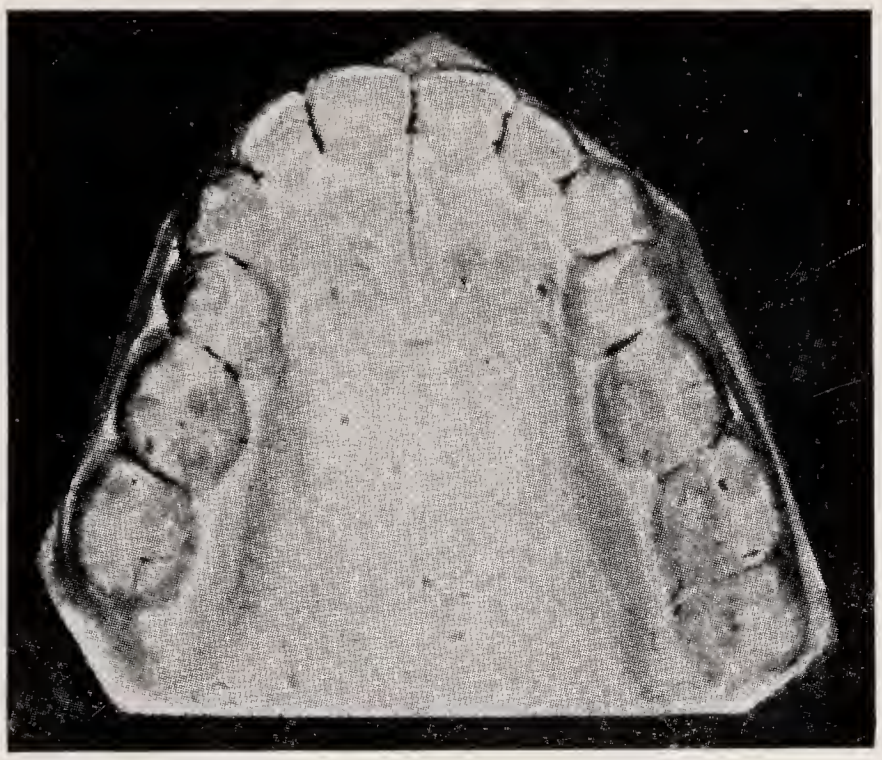


Fig. 4

Fig 5.

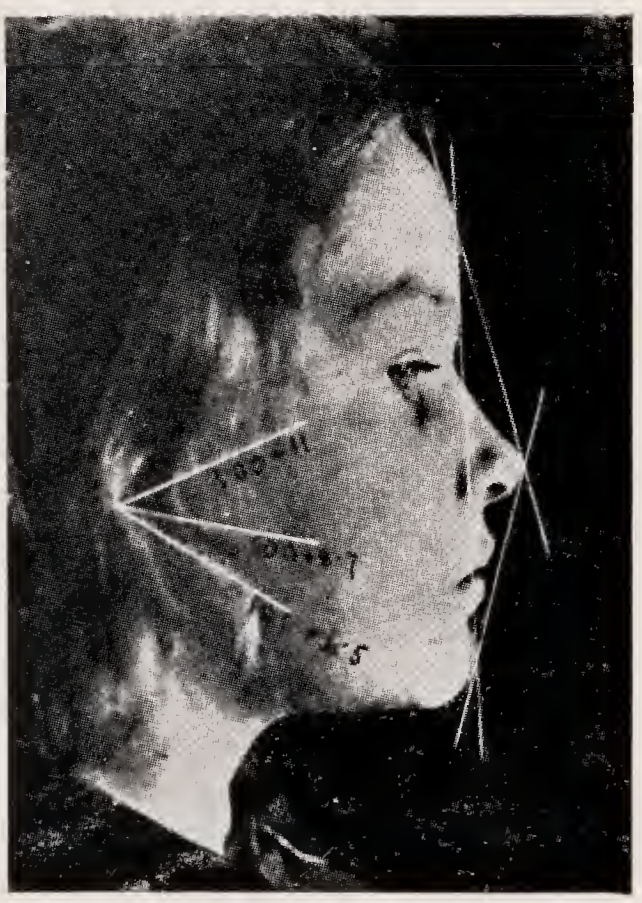


Fig. 6

Fig. 4 shows the upper dental arch after removal of a premolar on each side. The lower arch was similarly contracted.

Fig. 5 shows a similar case which was not observed and photographed till the abnormality had fully matured and the patient had reached the age of 36 years.

Fig. 6 is that of a girl aged 12 years 7 months which was selected by my friend Mr. John Millard the sculptor and myself on visiting a girls' school for the purpose of selecting some well-formed faces for measurement. Mr. Millard told me he thought this was the finest specimen of a growing face of this age he had ever seen. It presents, however, this particularity when compared with the means of Miss Smyth's corresponding age group, that the antero-posterior measurements are all in excess of the corresponding means of that group while the vertical measurements are uniformly below them. This may be regarded as one of the variabilities which we constantly meet in the study of these cases by the anthropological method of statistics.

It is plain at once in reading the Report that it was constructed with the preconceptions of an anthropologist, and that the point of view of the dentist was somewhat overlooked. This is an omission which has to be remedied to make the Report as complete as many of us wish to see it, and the points which will arise in considering the lacunæ which have been and will be discovered in it are points which we should have liked to consider with our old friend, the moving spirit in the formation of our Society—Dr. George Northcroft. It was on his initiative that the measurements of the younger children from 2 to 5 were first taken, and his interest in the scheme as a whole was great. We may be sure that had he lived he would have rejoiced to aid in discussing a Report containing such valuable material for the future study of so difficult a subject.

In being led to ponder again over the whole question of facial growth I came inevitably to compare measurements in the Report with some that I had made ten or twelve years before its publication. These measurements though made so much earlier (in 1921) were made on precisely the same method and are exactly comparable except where the age periods differ. These were published in the paper in which I had the honour of co-operating with Sir Arthur Keith, on "A Contribution to the Mechanism of the Growth of the Human Face" (2). But a comparison of the measurements made in 1921 with those of the Report would be invalid owing to differing age periods and the paucity of cases then measured. But the recasting of my knowledge which has taken place in the writing of this short paper has brought me to the assured conviction that the range of measurements should be extended to the age of at least 16 years. Their use in practice will in due time show us which facial characters deserve most careful observation and study and which perhaps may be profitably omitted from the series.

The foregoing observations have in part arisen from a series of discussions with Dr. E. Matthews of the Turner Dental School, University of Manchester, who has constantly urged me to record them for the benefit of others.

* * *

REFERENCES

(1) Medical Research Council—Facial Growth in Children, with Special Reference to Dentition, Part I by K. Corisande Smyth, Part II by Matthew Young. Price 1*s.* 6*d.*

(2) *Dental Record*, Vol. XLII, No. 2, 1922.

DISCUSSION.

Mr. H. Chapman, before reading the paper, said that Mr. Campion had arranged that Dr. Matthews, with whom he had been in close touch in recent years, should read his paper, but unfortunately Dr. Matthews was not able to attend the meeting, as he was examining at Manchester. When he told the members that Mr. Campion qualified as long ago as 1885 they would realise why he could not be present to read his paper himself, but Mr. Campion was still actively interested in orthodontics. He had been President of the Society in 1919/20 and had written on many subjects, including radiology. He had also collaborated with Professor Smith and Sir Arthur Keith in writing papers. He had made some most useful measurements, especially on the relation of the width of the central incisors to the breadth of the arch, and he had found that the breadth of the arch across the first premolars was about four times the width of the central incisor.

The President said the paper was a most interesting and lucid one and had drawn attention again to the valuable work done by Miss Smyth and Dr. Young. He often felt that orthodontists had not made as much use of that work as they should have, and he thought the paper was most timely.

It seemed to him that there would be some competition between the work of Miss Smyth and that of Dr. Broadbent in America. Miss Smyth and Dr. Broadbent had the same purpose in view in their work, but one had radiology as a basis for the work and the other had flesh and blood and measuring instruments as a basis. The fixed point in Miss Smyth's work appeared to be the transmeatal line. In Dr. Broadbent's work another fixed point was chosen, which went to prove that the transmeatal line shifted very considerably.

Mr. Wilson Charles said he did not think there would be any competition between the work of Miss Smyth and that of Dr. Broadbent, because, as he had pointed out to Dr. Friel after the publication of Dr. Friel's paper, Dr. Broadbent's work was founded on a misconception which even Mr. Campion made in his original paper, namely, that the pituitary fossa was a fixed point. It was not a fixed point, because it was bound during growth to move forward, and all Dr. Broadbent's measurements were therefore incorrect. Dr. Broadbent said that the transmeatal axis moved backwards. It could be shown to move forwards by microscopic examination and also by the measurements taken from the condyles at the base of the skull. The condyles could not move backwards, because they articulated with the transmeatal axis. It could be shown in a series of skulls, especially mammalian skulls like that of the pig, where plenty of the same family could be obtained, that during growth the only point which was approximately fixed was a point in the region of the condyle, which articulated with the transmeatal axis. Everything in front of that must move forward ; the sphenoid moved forward, and the pre-sphenoid moved still further forward. He could not see, therefore, how the work of Dr. Broadbent could affect that of Miss Smyth.

Mr. C. F. Ballard said he did not think it mattered if Dr. Broadbent used a point which was not fixed. Miss Smyth and Dr. Matthew Young attempted to measure points through soft tissues, whereas Dr. Broadbent in his technique attempted by X-rays to measure the bone. If Dr. Broadbent's technique was applied and a fixed point was used, or a point which moved was used and it was known how much it moved, that would probably supplement Miss Smyth's work.

Mr. H. G. Watkin said he understood Mr. Campion to say that the width between the premolars was about four times the width of the central incisor, and he would like to know whether the measurement was taken inside the premolars—the lingual distance—or outside. The force of the tongue must be taken into consideration. A patient with a small tongue could not maintain a wide arch.

Mr. H. Chapman said that the point to which Mr. Watkin had referred was not in Mr. Campion's paper. He had mentioned it in connection with the work which Mr. Campion had done. He did not follow Mr. Watkin's point, because Mr. Campion allowed considerable variability for the width of the arches according to the shape, and so on.

Mr. H. G. Watkin said Miss Smyth had informed him that the measurement was the lingual distance.

Mr. H. Chapman said the statement in question had been published by Mr. Campion in the *British Dental Journal.*

Mr. D. Baker said he had listened very carefully to Mr. Campion's paper but it seemed to him that, whilst the work described therein was of great interest from an academic point of view and of special interest to a few people who were closely connected with it, it was a long way away from the advancement of orthodontics from a practising point of view. He would be glad if some of the more experienced members present could tell him whether the fine measurements in question would help in the matter of diagnosis.

Mr. B. Maxwell Stephens, referring to Mr. Baker's remarks, said that theory did not always conflict with practice and he thought the use of theory became more apparent when one had made a collection of models of cases over a long period and could see the variation between them. It was then that one began to wish to measure the models and to help other members of the Society by supplying the measurements to them.

Miss K. C. Smyth said she was very sorry that Mr. Campion could not be present at the meeting. She would like to pay a tribute to him and she thought a very special vote of thanks should be accorded to him for producing a paper of the type in question, in view of his age and his many infirmities. He had taught her the method of measurement which she had used at the Medical Research Council and he had taken an immense amount of trouble to show her every detail of the measurements.

With regard to the movement of the soft tissues, to which Mr. Ballard had referred, it might not be generally realised that that movement, particularly of the soft tissues in the transmeatal axis or the external auditory meatus, was very carefully compensated

for in the latest type of prosopometer which she used, and which had been designed by Dr. Friel. The weight of the instrument naturally pulled on the external auditory meatus and dragged down the ear plugs, but the weight of the instrument was balanced on the top of the head by means of a pressure gauge, so that the ear plugs were kept in the centre of the axis and the pulling of the soft tissues was obviated as much as possible.

The President said he did not think that Mr. Baker attached no value to the knowledge of what was normal. He understood that what Mr. Baker wanted was some easier and more handy means of finding out the way in which a particular case deviated from the normal.

* * *

VARIATIONS IN RESPONSE

By K. E. PRINGLE, L.D.S.(Eng.)

I THOUGHT WE might profitably discuss this evening some of those variations of response to forces acting in the mouth, which are the essence of our subject, the study of orthodontics.

Hans Grüneberg (1) writing in 1937 about the teeth of the grey-lethal mouse described how in this mouse there was an absolute lack of response by way of bone absorption to the stimulus provided by the growing tooth germ. In the grey-lethal mouse " no tooth ever erupts."

He summarised his conception of the necessary conditions for response as follows :—

" The old scheme was :—

Stimulus (pressure) ———————————— Response (absorption

Now we have to fit in a new link :—

Stimulus (Pressure) — Hereditary Basis for Response — Response (Absorption)

This link is disturbed in the grey-lethal mouse. No response therefore can take place."

This conception has considerably influenced my way of looking at orthodontic problems and I have tried to use it to explain the variations or response to forces acting in the mouth. For general purposes I have modified the formula to :—

Stimulus ——— Basis for Response ——— Response.

for it seems to me that factors other than hereditary factors can be included in the basis for response, or at least that an hereditary basis for response can be considerably modified by other factors. Here is an example :—

Case 1. (Fig. 1.) This boy aged now 10, lived near Rotterdam during the German occupation. The daily or almost daily ration was, I have been told, one half-pint of sugar beet soup, occasionally augmented by a piece of so-called " cake." Several times the boy fell down through starvation. The effects on the teeth were that the incisors were unable to stand the stresses of occlusion and very rapidly became proclinated and loose, a process which under normal conditions might have taken many years. His aunt had a very similar collapse of teeth, which became extremely loose. His mother had the same condition but not to the same extent. His younger sister lost her temporary incisors at four years of age. There was an accelerated response to a normal stimulus through a change in the basis for response.

It seems to me also that such a condition as rickets represents a change in the basis for response.

Are there any other conditions, which while not perhaps absolute can be taken as analogous to that of the grey-lethal mouse ? I would say that in the condition of cleido-cranial dysostosis we have to look for some abnormality in the hereditary basis for response to

account for the delayed eruption of the teeth. What that abnormality is we do not know but it is to my mind useful in thinking of orthodontic problems to try to see clearly in what direction we have to look for a solution. Lewin Payne (2), Rushton (3) and many others have recorded cases of this condition. Speaking from the dental point of view only, the chief findings were : delayed eruption of teeth even when there was room for eruption and very frequently the presence of supernumerary teeth. If we look at these findings from the point of view of this formula we shall see that the lack of response (in this case lack of eruption) may be due either to the stimulus (in this case mechanical prevention of eruption by the presence of supernumeraries) or as I have said to an abnormal basis for response of hereditary origin. The fact that in many cases there are no mechanical obstructions in the form of supernumerary teeth indicates that the chief error lies in the basis for response.

To me the value of this formula is that it is broad enough to include any problems we may have connected with growth and development. It enables us to think of our problems in larger terms without the necessity of going into details. There is, however, one aspect of the basis for response that must be mentioned : namely, that it is constantly changing with age. Age is connected with the completion of processes each of which has a definite time in which it can be completed. That living processes are not of a constant nature but vary with age is obvious to all.

Now we come to that puzzling condition of the submerged or partly submerged temporary molar. We know how certain temporary molars fail to rise with the line of occlusion, how once having stopped they appear to be forced downwards into the gum by pressure from adjoining teeth. We know that they can become completely submerged under the gum but that this is not the usual process for as a rule they are lost more or less at the usual term (4, 5, 6). My view of the mechanism is that owing to an error, perhaps a slight error of timing on the part of the body, the reason for which is still not clear, instead of continuous absorption taking place there is a time, perhaps a short time, when an interruption or holding up probably with ankylosis takes place. This brings the tooth slightly below the line of occlusion. Later mechanical forces hold and push the tooth down but at any stage up to the normal term a new wave of absorption can take place obliterating the ankylosis and freeing the tooth so that it is shed in the normal manner.

If the tooth is retained much beyond the usual term ankylosis is again likely to result, although probably some absorption will still be found. In the past some observers have said that they consider the condition is not associated with ankylosis, while others have said that it is. Both views are correct. It is simply a question of timing. Absorption is not a process which continues steadily and without pause. At any time there can be a pause. Deposition can then take place.

G. B. Pritchard (7, 8), speaking of absorption in his studies of ankylosed teeth, mainly unerupted teeth with some degree of infection present, says, " The invasion may start either on the enamel surface or the cementum, and passing deeply in may again attack these tissues from their dentinal surfaces. Active calcification of the

invading tissues occurs in certain areas, while absorption is still in progress in others and the newly formed tissue is bone. This appears to be in continuity with the bone of the tooth socket and thus produces a phase in the process of a complete absorption of the tooth and its replacement by bone.

It would then appear that this replacement is seldom completed."

Here then we see two processes at work: absorption and deposition. They are complementary to each other.

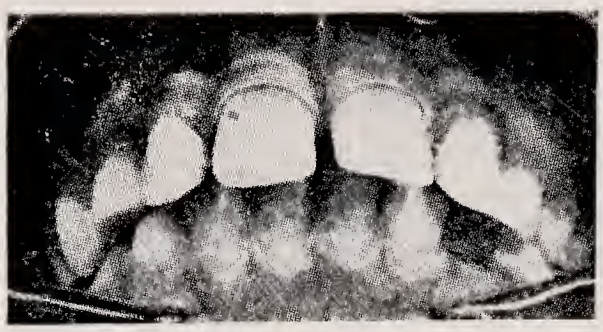


Fig. 1

Fig. 2. *First Model. Age* 8 *years* 8 *months*

Fig. 3. *Model at time of extraction. Age* 10 *years* 2 *months.*

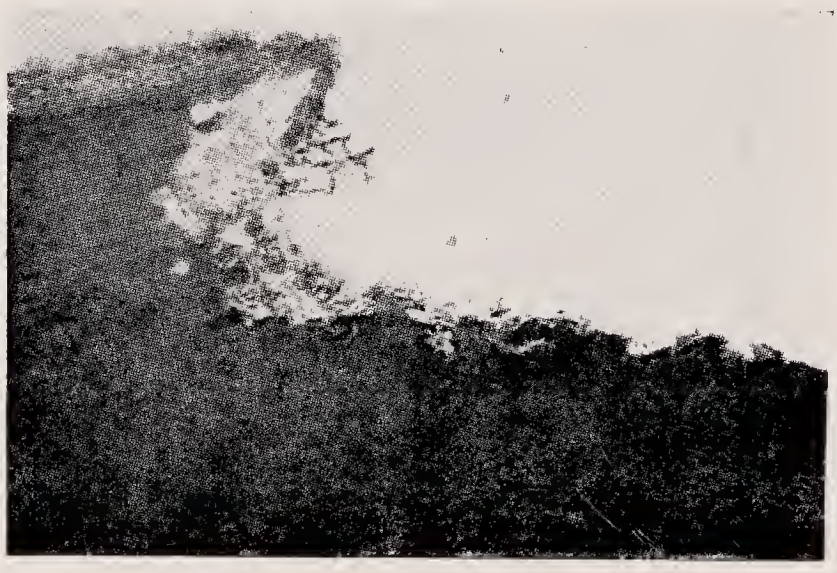


Fig. 4. *Microphotograph* x160. *Shows absorption only.*

Fig. 5. *First Model. Age* 7 *years* 6 *months.*

Fig. 6. *Model at time of extraction. Age* 9 *years* 11 *months.*

Fig. 7. Microphotograph x160. *Shows absorption and ankylosis with tearing of bone away from the site of deposition.*

Here are two cases of partly submerged temporary molars illustrating how histologically you sometimes find ankylosis and sometimes you do not.

Case 2. (Figs. 2, 3, and 4.) *Case* 3. (Figs. 5, 6 and 7.)

As I said we still do not know what is the cause of the failure in timing of the process of eruption of these teeth though we suspect, as Capon (5) showed in one of his cases, that abnormal tongue position may have something to do with it.

For a short while I want you to consider our present knowledge of growth and movement in the jaws. From the past we to-day have inherited a great deal of knowledge as to the form and size of the teeth, the form and relations of the arches and so on. Looked at from a static point of view the subject is more or less completely worked out, but orthodontics takes into account movement and herein lies its interest. Of our knowledge of movement a great deal has been contributed by members of this Society using various techniques, such as serial models. Most of this we have absorbed. Now, by the use of cephalometric röentgenography, a technique first used by Broadbent (9) a great deal of scientific information is coming to us from the United States. Gradually piece by piece the growth of each part of the head and jaws is being worked out. Much of this material confirms what was assumed before but much of it is new.

What marvellous processes are revealed, when the living process of growth is studied, where change is the only constant. Examples abound of quickenings, of retardations, of changes of form, of changes of position, of changes of function, of one force being replaced by another, of variations of response, each case responding according to the way of its kind but in its own special way as well.

To illustrate timing, I am going to show a diagram contained in an essay by H. Carlson (10), which won the annual prize award offered by the American Association of Orthodontists. (Fig. 8).

Here we see how each tooth goes through the same process in its path to eruption ; a gradual rise at the start, a rapid rise during 1—2 years before reaching the line of occlusion, a gradual rise again with the line of occlusion. You can see how small errors in the timing of this process can lead to various irregularities that we

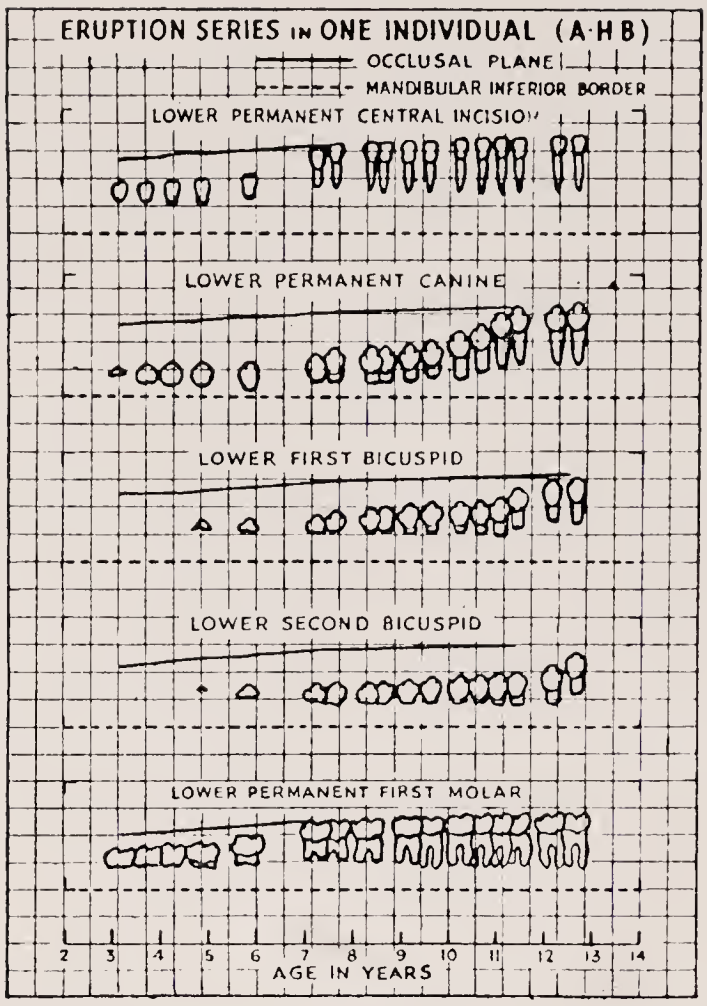


Fig. 8.

commonly see. Lewin Payne (2) remarked how teeth once delayed by mechanical forces were slow to complete their eruption, even after the obstruction had been removed. He was really describing teeth, which had failed to take advantage of their optimum time for eruption.

To illustrate the general aspect of timing and the almost new way of looking at our subject I am going to read part of the preamble to a paper by Associate Professor Moses Diamond (11). Diamond quotes Arey as follows: " The growth of the body and its parts, organs, and functional systems is a pulsating process, which shows marked changes in rate from time to time. Many of these definite periods of alternate acceleration and slowing have been determined and commonly designated as ' stretching ' and ' filling '."

Diamond goes on to say, " The various components of this concise statement require amplification. One of these is the rate of growth. Growth rate is never of an even nature. It consists of alternate intervals of acceleration and retardation. These intervals of acceleration and retardation are different with each organ of the body." Later he says, " While these growth cycles of acceleration and retardation are independent for each part of organ of the body, there is an important interrelation between the growth cycles of adjacent parts."

To me it seems that in the next period orthodontic study will be very much concerned with the variations of timing in growth processes and with the relations between the growth processes in associated parts. Note again that these variations of timing are part of the " Basis for Response."

Up to now we have confined ourselves to the " Basis for Response." Now for a short while I want so speak of orthodontic treatment, which is concerned with producing response by the application of new forces. Clearly, if the basis for response was always the same we

should be able to produce always the same response to the same stimulus. That this is not so is obvious to us all. As Oppenheim (12) has said, "The reactions to the same force are different in different individuals." Risking the obvious I would add that the reactions to the same force are different in the same individual at different ages. I can think of quite a number of cases, where the correct force has been applied for quite a long period without result and then suddenly the case has resolved itself, often within a matter of weeks.

To illustrate the difference of response to intermaxillary traction to bring forward the lower arch, I want to show you three cases.

Each case was treated by upper expansion followed by intermaxillary traction. Of course the forces used were not exactly the same, but these cases may be of interest. They were all cases under the care of Mr. Bocquet Bull at Guy's ; treatment was mainly carried out by House Surgeons under my supervision.

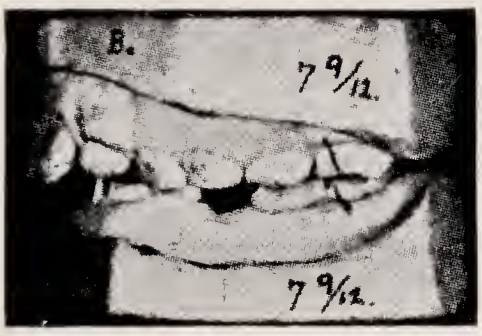


Fig. 9. *Before treatment. Age* 7

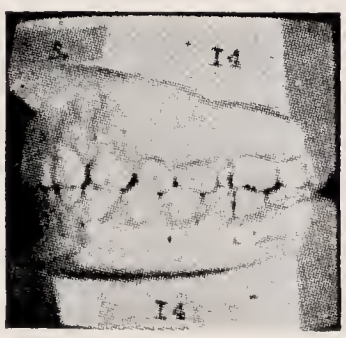


Fig. 10. *After treatment.*

Fig. 11. *Two years after retention finished. Note slight relapse.*

Fig. 12. *Photographs before treatment and two years after retention finished.*

Case 4. (Figs. 9, 10, 11 and 12.)

Movement seems to have been mainly in the upper arch, although the mandible has probably come forward a little. This case went fairly smoothly, although there were a few breakages in the early stages. Intermaxillary traction was used for 3 years. Since the completion of treatment there has been a slight relapse. The patient can still bite back a half unit.

Case 5. (Figs. 13, 14, 15 and 16.)

This patient was the younger sister of the first case. For several years she broke everything we tried but in the end suddenly seemed to get better. Movement seems to have been confined to the upper arch with no forward movement of the mandible. Intermaxillary traction was used for three years. I do not believe there has been relapse in this case because I do not think the mandible was ever stable in the forward position.

Case 6. (Figs. 17, 18, 19 and 20.)

This case went surprisingly well, when everything seemed against a good result. The patient was twelve years of age at the commencement and had already lost $\overline{6|6}$. The response to intermaxillary traction was immediate, the mandible definitely coming forward. After the mandible had been forward for some time, we were uncertain of the stability of the upper arch. $\underline{5|5}$ were removed and the remaining teeth aligned. Intermaxillary traction was used for one year but had done its work in six months. I think that since retention has ceased there has been a slight relapse.

Mr. Chapman (13, 14), in his papers in 1937, gave very high marks to intermaxillary traction for the treatment of Class II Division I in cases where growth of the arches was normal. This is perhaps correct. This method is highly efficient in the sense that it nearly always does something, but I think these cases show that you cannot take perfect results for granted. If you take cases that are suitable some go beautifully, miraculously almost. A few show no apparent change for the better. The majority benefit considerably from the point of view of appearance and perhaps health ; enough to satisfy the patent but not enough to satisfy the operator. This refers to suitable cases. The majority of postnormal cases, more so of course in hospital than in private practice, are unsuitable and it is well to remember that a perfect result is unlikely where there is :—

1. Lack of growth, loss of space and movements of the teeth due to early extractions.
2. Inability on the patient's part to understand what it means to bite forward.
3. A considerable lack of occlusion, when the mandible is placed forward.
4. Lack of interest, lack of cleanliness and so on.
5. A family or personal history of bad luck, illness and accidents.
6. Boarding school and evacuation.

Let us return to the cases that are suitable. They respond differently in the hands of the same operator. The answer must lie in the basis for response. How different this can be even with the same patient at different times ! You can sometimes persevere for a long time with little effect and then suddenly you will find the case has resolved. In another case there will be an almost immediate response and then you will after all find it very difficult if not impossible, to get the mandible forward the last half unit.

Just now we spoke of relapse. From the point of view from which we are speaking this evening relapse following treatment with appliances is simply response to the forces remaining after the removal of appliances. It varies both with the stimulus and with the basis for response. If during treatment we in some way alter the forces

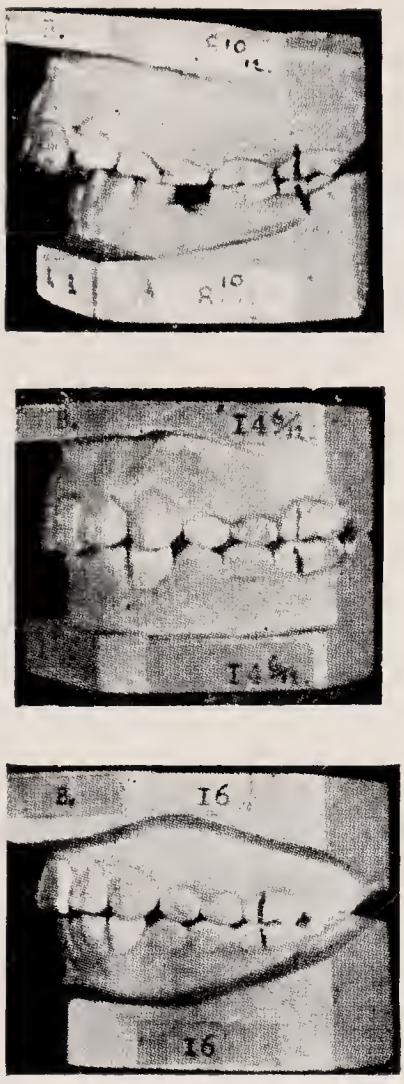


Fig. 13. *Before treatment.*
Fig. 14. *After treatment.*
Fig. 15. 1 *year* 6 *months after the end of retention.*

Fig. 16. *Photographs before treatment and* 1 *year* 6 *months after the end of retention.*

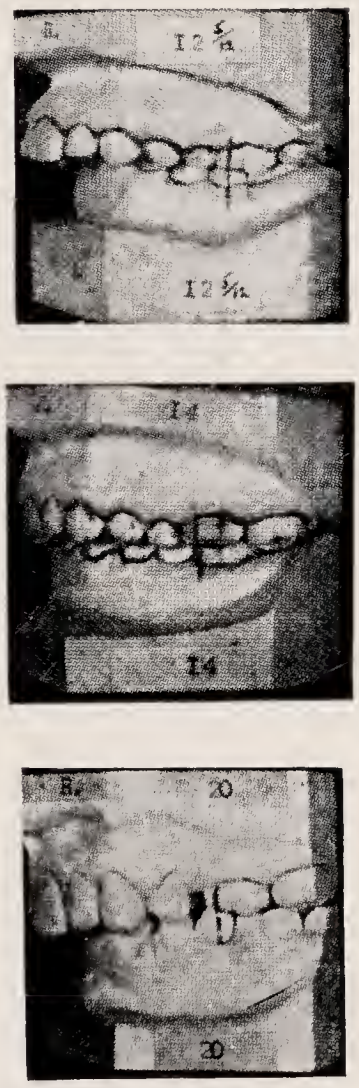


Fig. 17. *Before treatment.*
Fig. 18. *Towards the end of treatment.*
Fig. 19. *About* 5 *years after the end of retention.*

Fig. 20. *Photographs before treatment, towards the end of treatment and about* 5 *years after the end of retention.*

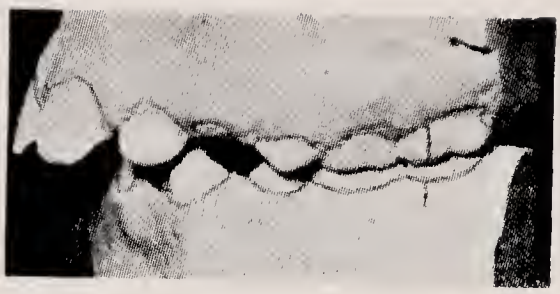


Fig. 21. Before treatment. Age 9 yrs. 6 months.

Fig. 22. After treatment. Age 13.

Fig. 23. Two years after the end of retention. Age 15 years.

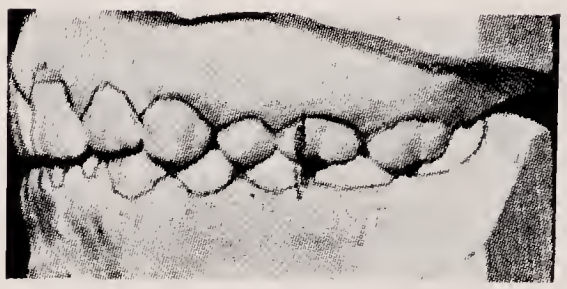


Fig. 24. Four years after the end of retention. Two years after extraction of $\overline{7}|\overline{7}$. Age 17.

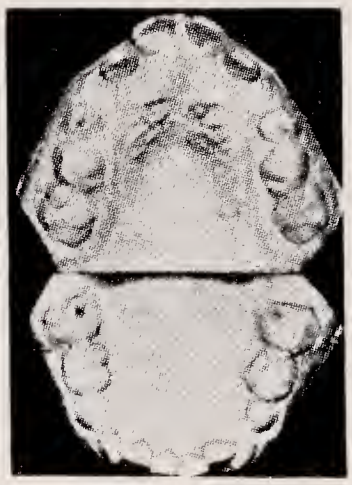


Fig. 25. Upper and lower arch before treatment. Age 9 years 6 months.

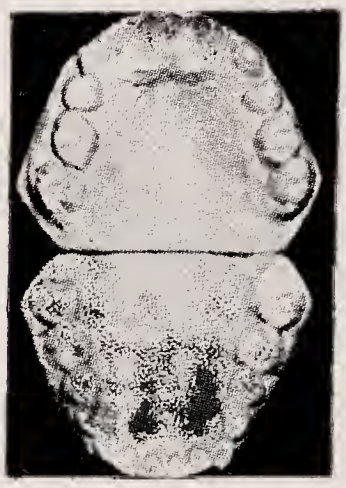


Fig. 26. Upper and lower arch after treatment. Age 13 years.

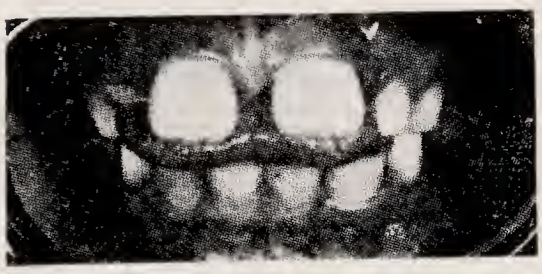
Fig. 27. Upper and lower arch two years after end of retention. Age 15 years. Relapse of lower incisors.

Fig. 28. Upper and lower arch four years after end of retention. Two years after extraction of $\overline{7}|\overline{7}$. Age 17 yrs. $\lfloor\overline{1}$ fractured in a fall.

Fig. 29. Lateral photograph.

Fig. 30. Photograph of teeth, $\frac{ED \mid D}{D \mid E}$ *Extracted at 6 years 2 months.*

Fig. 31. This case shows open bite in spite of early extractions, the patient being a thumb sucker. Age 7 years 10 months.



Figs. 32 and 33. This is the same patient. Not only does he suck his thumb (nowadays secretly) but his tongue is also to be found between his incisors. (The case shows no loss of lower spaces.) If you look carefully you will see that the tongue also protrudes into the spaces left by the extractions.

Fig. 34. One temporary molar lost at 5 to 6 years. Remainder lost at 7 yrs. Age now 8 years 9 months.

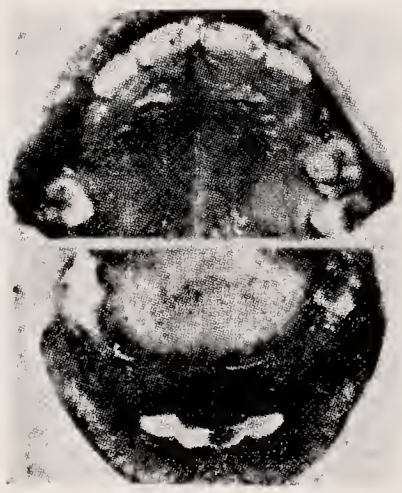


Fig. 35. Occlusal view of upper and lower arches.

operating we must expect the new alignment we have made to react to the new set of forces we have called into play. We change the forces when we push a tooth over the bite, sometimes we change the forces, when we succeed in altering the joint with intermaxillary traction and we change the forces for better or for worse, when we extract teeth. For orthodontic treatment to be successful a change of forces must be achieved in some way or another.

Case 7. (Figs. 21 to 28).

Here is a case where the lower arch was slightly postnormal. Treatment was by an upper bite plate, extraction of $\underline{4 \mid 4}$, retraction of $\underline{3 \mid 3}$ and forward movement of $\overline{12 \mid 12}$, retraction of $\overline{12 \mid 12}$, retention and lastly extraction of $\overline{7 \mid 7}$.

This case illustrates how extraction of upper premolars can produce a permanent change of forces, how a correct relation of incisors and canines tends to remain stable. It also shows how simple forward movement of lower incisors is liable to relapse as no forces have been changed. I have often wondered whether, if I had removed $\overline{7 \mid 7}$ before retention ceased, the lower incisors would have remained in their correct position.

This is all I want to say here about response to treatment. I have shown that this varies not only with the stimulus but with the basis for response.

Lastly, I want to show you a few slides, which show exceptions to certain rules, which generally apply, when temporary teeth are extracted early.

In 1937 (15) I found that of the children attending as orthodontic patients at Guy's Hospital over 80 per cent, who had had upper and lower temporary molar extractions, had a deep incisor overlap.

Here is a typical example.

Case 8. (Figs. 29 and 30.)

I often asked myself " Why don't all cases of this kind have a deep incisor overlap ?" I was struck at the time by the number of partial open bite cases in which there seemed to be no closure of the bite at all following early extractions. Gradually since that time I have come to see that many of the exceptions to the general rules as to the movements following early extractions are due to local prevention of those movements.

Here are some examples :

Case 9. (Figs. 31, 32 and 33.)

Case 10. (Figs. 34 and 35).

This case also illustrates the same point. Temporary molars were removed at 7 years 5 months of age but the lower spaces were not lost as the tongue filled the spaces.

I have seen that some people (16) maintain that the usual sequelæ of temporary molar extractions do not follow, where there is normal growth. Now normal growth is connected with the basis for response. Personally I think the main reason lies elsewhere, i.e. in the stimulus.

It is tongue habits which control to a great extent the form of normal growth and the form of the lower arch, although of course normal cell activity is necessary as well. Mr. Rix (17) in his address last month showed us, what we have to investigate next. We need a much more accurate knowledge of tongue habits during deglutition and speech.

I have brought you forward this evening material for discussion and at the same time have tried to indicate where we must look for the answers to some of our orthodontic problems. I have also tried to show that profitable future research lies in the further study of local pressures on the teeth and in the further study of the timing of the different processes that make up that highly complicated process the growth of the jaws.

I should like to thank Mr. Bocquet Bull and Mr. R. E. Rix for allowing me free use of their cases, Mr. G. B. Pritchard for his expert advice on the sections of submerged temporary molars, and the Dental Council of Guy's Hospital Dental School for allowing me the facilities of the Research Laboratory. My illustrations were prepared by Mr. J. F. Dudley of the Dental Research Laboratory and Miss Treadgold of the photographic studio. To them both I wish to express my very great appreciation. Lastly, I wish to thank Mrs. Lindsay for her invaluable assistance. London Photocraft Ltd. very kindly gave facilities for making photostat copies of the paper.

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DISCUSSION.

The President said the members were very much indebted to Mr. Pringle for his original paper, which ranged over many interesting conditions. It was true that in the practice of orthodontics

a given stimulus did not necessarily produce a given response. Some hidden element was always creeping in to confound orthodontists' expectations and keep them humble, and it supplied the most stimulating element in their calling. It tended to direct their minds back to original causes, the study of which was the only endeavour which would be ultimately profitable.

He hoped the paper would not lead anyone to think that it was not possible to generalise in orthodontics. Without generalisation orthodontics could not be taught and practitioners would stand bewildered and impotent before cases which were daily being treated successfully now.

With regard to the submerged deciduous molar, during the Christmas holidays he had seen a case which he thought went a long way to prove that the adjacent teeth did not necessarily take any part in forcing the particular tooth below occlusal level. The case was that of a child aged 12 years. On one side the upper 6 was impacted against the distal aspect of the second temporary molar, a condition which was fairly frequently seen. One would expect the upper 6 to be exerting a downward thrust on the second temporary molar, yet the deciduous molar was almost completely enveloped in gum. It was a long way from the occlusal level, and the 6 was almost out of sight, with only one or two cusps showing.

Mr. H. Chapman said that Mr. Pringle had sent him a copy of the paper, so he had had some time to think about its contents. He would like to thank Mr. Pringle for the excellent photostatic copy of the paper which he had received and which included the illustrations. He thought such a copy was unique in the annals of the Society and he congratulated Mr. Pringle on it.

The paper made the members think, and that was what they expected from Mr. Pringle, who not only thought for himself but made others do the same.

When he saw the title of the paper, he did not know exactly what it meant or how Mr. Pringle would deal with the subject, and he asked himself whether it was something new in orthodontics or was a way of expressing something which orthodontists had had in mind previously. He thought it could hardly be said to be something entirely new, but it might make orthodontists look at things in a different light, as Mr. Pringle suggested. He had come to the conclusion that " variations in response " was an expression which included prognosis and, as Mr. Pringle had indicated, etiology and treatment. Whether it was politic to bring the expression " variation in response " into the orthodontic vocabulary was a matter for consideration. He had been shocked last week to find that students, at a period of their career when they ought to have been able to state the meaning of the words " etiology " and " diagnosis," could not immediately give him the meaning of those words, so how they would deal with " variations in response " he did not know.

He agreed that hereditary factors were not the only ones to be included in the basis for response. It seemed to him that heredity might be either a favourable factor or an unfavourable one, and he was of the opinion that in some cases, while it might be a factor in the etiology of malocclusion, that need not militate against treatment, so that it might not be an adverse factor in the consideration of the prognosis.

The first case shown by Mr. Pringle struck him as being one of a type which was very frequently seen, and he would have hesitated to attribute the proclination of the upper central incisors to the factors to which Mr. Pringle had attributed it. The picture seemed to him to be a typical clinical one.

With regard to the question of supernumerary teeth causing delayed eruption, it was not known that they in fact caused delayed eruption but they were known to be associated with it. The most marked example was a clinical condition in which the upper permanent laterals had erupted but one or both of the centrals had not erupted. In those cases there was always a supernumerary tooth in relation to the unerupted central incisor, or to both of them if they were both unerupted. It would therefore seem that there was some relation between the supernumerary tooth and the unerupted central incisor, but that was not the same thing as saying that the supernumerary tooth was the cause of the failure to erupt. There were, of course, more frequent cases in which supernumerary teeth were present and the eruption of the other teeth was not affected.

He did not know whether Mr. Pringle was referring only to teeth which were below the occlusal level or whether he included also those which were actually submerged.

Mr. K. E. Pringle : Only those below the occlusal level.

Mr. H. Chapman said that was such a common condition that he would regard it as a variation of the normal rather than as an abnormality. When the teeth were so submerged as to come under the heading of the French "*desinclusion*" he thought the condition might be regarded as abnormal.

He was much interested in Mr. Pritchard's work, to which Mr. Pringle had referred, because he remembered talking to Mr. Pritchard about that work some years ago and gathering that Mr. Pritchard had never seen ankylosis of deciduous teeth. He himself had been under the impression that ankylosis of deciduous teeth could occur, and he had been disapponted to find that Mr. Pritchard held the opposite view. Perhaps he had changed his view since then.

Mr. K. E. Pringle : Mr. Pritchard has seen ankylosis in ordinary absorbing temporary molars, and it is not uncommon.

Mr. H. Chapman said that, with regard to timing, he had seen a child that afternoon who had a rather unusual condition. The child was 8 years of age ; the lower permanent centrals had erupted, the deciduous laterals were still present, the left upper lateral had erupted but the right upper one had not erupted, and the mother said that the space for it was closing. He could only imagine that it was closing by all the back teeth moving forwards, and that was in consonance with the clinical appearance. Apart from that, the child had a perfect set of teeth and beautiful occlusion.

It seemed to him that the stretching and filling out periods of Professor Diamond were very similar to the springing up and filling out periods of Professor Harris. Hillman also had a similar theory about the optimum time for treatment, which in boys was 10 years 9 months and in girls was 12 years 7 months. It did not seem to him to be right to delay the treatment of children till those times, because the point that from birth onwards the rate of

growth was gradually slowing down should not be overlooked. For example, the mandible doubled its size in the first 15 months of life, and after that its growth was less rapid each year, so the trend of growth was to slow down and the springing up periods were only an acceleration at a particular point. The growth might not be as rapid then as it was earlier.

He would be interested if Mr. Pringle could say why, when he used intermaxillary traction, the movement was mostly in the upper jaw and whether the intermaxillary traction accounted for that. Nature allowed for great variability in the visual aspects of the normal, and it was important for orthodontists to know the various aspects and to be prepared to meet any new aspects at any moment. He could not believe that in normal cases variations of timing in the growth processes of associated parts would lead to abnormalities. They might lead to local ones, but he did not think they would lead to more fundamental abnormalities. In his opinion, intermaxillary traction gave very good results not only where there were normal arches but also where the arches were small. He agreed that not all the cases were successful. In the last two or three years he had had two cases which had been most disappointing to him. He preferred to treat a very bad case of the Class 2, Division 1, type than to treat ones of mild degree, which he found most unsatisfactory, because at the best there was not a great amount of improvement to be obtained, and unless the maximum amount was obtained comparatively little good was done.

He would like to know why Mr. Pringle said that the majority of cases of postnormality were unsuitable for hospital treatment. Mr. Pringle regarded the relapse of the lower incisors in one of the last cases he had shown as being explained by the fact that the arches could not be enlarged, so he did not understand what was in Mr. Pringle's mind.

He would also like to know in what way the extraction of the lower second molars changed the direction of the forces.

He congratulated Mr. Pringle most heartily on the good results he had shown that he had obtained at Guy's Hospital Dental School and also on the excellent presentation of his paper.

Mr. H. G. Watkin said he would like to thank Mr. Pringle for his valuable paper, which would be useful to all orthodontists.

Mr. Pringle had called one of the early cases he had shown on the screen a Class 2 case, but his own diagnosis was that it was a Class 1 case to start with, before intermaxillary traction. It was well known that the distal edges of the E's were vertical at about 7 ; consequently the mesial edges of the 6's were also vertical, and the case was not Class 2 but was Class 1 at that age.

He agreed with Mr. Pringle that the orthodontists must do two things ; he must put the teeth where he wanted them to be and he must also do something to make them stay there, such, for instance, as extracting a tooth.

Miss K. C. Smyth said that Mr. Watkin had referred to the relationship of the distal borders of the deciduous molars, basing his remarks on Professor Friel's description, but, having been a student of Professor Friel's, she would like to correct Mr. Watkin's statement. The relationship that he had described applied to children of 3 years of age, and by the age of 6 or 7 that relationship should have altered and the lower jaw should have come forward.

The distal border of the lower deciduous molars should be in advance by 7 years of age, so that the first permanent molar could come directly into normal relationship ; otherwise it would come down in cusp to cusp relationship.

With regard to ankylosis of deciduous molars, she had not given the matter a great deal of thought, but about three weeks ago she had seen a child of $13\frac{1}{2}$ who had one of her lower canines erupting entirely inside the arch and internal to the lingual edge of the deciduous canine. She sent the child back to her dental surgeon to have the remaining deciduous teeth in the lower arch removed. The premolars were well up. The roots of the deciduous molars were partly absorbed, and she felt that, as the child obviously had to have the canine removed, she should have the remaining deciduous molars extracted. She thought they were overdue to be shed and probably would be shed quite soon. There were five teeth due to come out. The child came back to her with the report that the dental surgeon (whose skill was quite above reproach) had been unable to extract more than two teeth. The extractions had been very difficult. She had hoped to take an impression but had been unable to use more than a very slight pressure, because the sockets were so torn, and there were several pieces of bone lying about in the soft tissues. She thought the fact that at $13\frac{1}{2}$ the deciduous molars were so very difficult to extract and that pieces of bone were lying about in the sockets indicated a condition of ankylosis.

Mr. C. F. Ballard said he would like to congratulate Mr. Pringle on having produced such a large amount of material for discussion.

He thought that a favourable response to orthodontic treatment was dependent on an accurate diagnosis being made, and at the moment orthodontists were not sufficiently advanced in their understanding of bone growth, muscle action and perhaps local reactions in the alveolus to make a proper diagnosis. He thought that was the reason why many cases proved to be failures.

With regard to intermaxillary traction, he very much doubted whether in, for instance, the third case which Mr. Pringle had shown the mandible had actually been advanced. Mr. Pringle said he thought it had come forward, but it was very difficult from the photographs to be absolutely certain of that. He thought that a better occlusion had been produced because the mandibular dentition had come forward. The teeth in front of the first permanent molars were quite definitely tilted distally, and intermaxillary traction would bring the incisors forward and permit the premolars to come forward, thus producing a better occlusion. He did not think the three photographs showed that the chin had advanced in its relationship to the orbital plane, and he could not say that in any of the cases in which he had used intermaxillary traction and had produced a normal occlusion he had brought the mandible forward in relation to the orbital plane. He thought that in most of the cases he had produced normal occlusion through a forward movement of the mandibular dentition and a distal movement of the maxillary dentition.

In his opinion, the fact that some cases tended to relapse was due to the fact that the orthodontist failed to recognise that many postnormal occlusions occurred owing to a lack of antero-posterior

space on the apical base and that many relapses were due to the second and third permanent molars. The maxillary dentition was pushed backwards and the mandibular dentition was pulled forwards, but owing to the development of the second and third permanent molars the work which had been done was undone. That might be a variation of response, but, in his opinion, it was a failure in the original diagnosis.

Mr. R. Cutler said he would like to thank Mr. Pringle for sending him a copy of the paper. It was the first paper that he had seen reproduced photostatically, and that method had the great advantage of allowing automatic reproduction of both photographs and line drawings. For a plain script a Roneo reproduction was probably the quickest and cheapest, but where line drawings or photographs had to be reproduced the method chosen by Mr. Pringle seemed to him to be excellent and he would advise other members to study it.

He hoped that Mr. Pringle's paper had given satisfaction to Mr. Baker, who seemed to cavil at the nature of the paper by Mr. Campion. There was always antipathy between the practical man and the academic man. The practical man thought that the academic man was a scientific nihilist, and the academic man thought that the practical man was a reactionary blimp.

Most orthodontists started (he thought quite praiseworthily) by endeavouring to get the maximum degree of efficient mechanical control of any given case, and, when the orthodontist had learned to exert efficient mechanical control, he realised that the other two important factors (perhaps the only two) were, first, to make a correct diagnosis and, secondly, to intervene at the right stage. He supposed that most failures in the last analysis were due to incorrect diagnosis, intervention at the wrong time, or inefficient mechanical control. Mr. Pringle had rightly emphasised the need for intervention at certain given times, and he was sure that all orthodontists could study his paper with the greatest profit.

Mr. K. E. Pringle, in replying to the discussion, said that in the first case he had shown, to which Mr. Chapman had referred, the teeth of the boy in question and of the other members of the family collapsed suddenly, in six months or less. He doubted very much whether under ordinary conditions the case would have gone as badly as it in fact did.

With regard to postnormal cases being unsuitable for hospital treatment, it was not a question of the hospital treatment but of the cases that came to the hospital. In private practice gross irregularities due to early extractions were very rarely seen, but in hospital they were still seen.

As to Mr. Watkin's remarks, personally he was not very much interested in the way in which the molars occluded. In the case to which Mr. Watkin had referred, the photographs showed that the child was postnormal, and how the teeth occluded did not seem to him to be the point that mattered. It was what the child was, and not what the teeth showed. He thought Miss Smyth was correct in what she had said on the question raised by Mr. Watkin.

On the motion of the President, a vote of thanks was accorded to Mr. Campion and Mr. Pringle for their papers, and the meeting then terminated.

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ORTHODONTICS AND COMMON SENSE (Part II).

By L. RUSSELL MARSH, L.D.S.(Eng.)

MANY YEARS AGO I read before this Society a paper which I called "Orthodontics and Common Sense." The Society, always to the fore in upholding national tradition, never fails in kindness to the maiden effort. I enjoyed that kindness. I was and am grateful. Even the title was not challenged. A cynic's reply to "orthodontics and common sense" might well have been that you can't have both—if you had common sense you would not be an orthodontist. But even this was not held against me. It is perhaps no more than characteristic of such a paper that it obviously lacked the support of those years of sober experience which go to make the complete orthodontist realise his utter incompleteness. That I have ventured today to call my present paper Part II of the same series is to some extent due to my interest in how little and yet how much my views have changed during the intervening years.

It is true that I can no longer, as I did then, anticipate sympathy for an espousal of the cause of the younger man, although I have not yet reached the age that considers that all young men should be abolished. I must confess that I am not so sure now that our sympathy is not wasted on the embryo orthodontist. He is perfectly free to look round at his older colleagues, and to note the haggard, dyspeptic, careworn faces that have not smiled in twenty years. These marks he sees on our faces are not caused by dissipation (much) but by blood, sweat and tears, of which the sweat at least was our own ! If after looking at us he decides to continue, then he is so obviously the sort of martyr who cannot be happy unless he is miserable, that we can only wish him a regretful "Godspeed." However, I propose to do what I can to help him by trying to clarify certain obscurities which may be a source of perplexity and frustration to him, as they were to me. To do this in full would make too great a demand upon your patience, so I will be as brief as possible, and I have no doubt that all the questions (if not the answers), will come up during the discussion. If at the end he finds himself a little more perplexed than he is now I can only rely upon that small and grudging tribute which is due to one who means well.

In Part I it appears that in attempting to advance a moderate view I expressed myself so badly that I have since been claimed as a supporter by enthusiasts of one extreme and as a danger by those of the other. I will try not to repeat this error. But I still think that orthodontics is one of the most difficult of all sciences, and that, because our work affects individuals whose health, appearance and happiness are at stake, we have no right to neglect any method of treatment or any form of apparatus that may help us to attain a successful permanent result.

I am no less humble now than I was thirteen years ago, but I find I am a little less apologetic.

* * * * * *

Not so very many years before our time dentistry emerged from the obscurity of the barber's shop and began to be practised as a

new science by men who called themselves dentists. A little later a group of earnest and sincere dentists banded themselves together in an honest endeavour to regularise their profession. They said in effect, " We will not extract teeth, we will save them. By these tokens shall ye know us from the common herd." (They also said, " We will not advertise," which was the subtlest idea in advertisement yet advised, but that is by the way.) These earnest and honest men were as good as their word, or almost so. They devitalised pulps, they drained abscesses, they treated pyorrhœa, they crowned stumps and they bridged gaps. There was no limit to their ingenuity. They raised technical dentistry to superb heights, and they showed us what can be done with teeth. And always that distinction from the common herd, " We will not extract teeth." It was a wonderful effort and it went too far, as do all extremes, but, mark you, it served the purpose of rapid advancement. A split occurred in the ranks of these honest men. X-ray, the medical profession, and the health of the patient gave rise to doubts. The pendulum swung violently to the opposite direction, and teeth were extracted on the slightest suspicion of oral sepsis. Two extremes of opinion existed at the same time and bitterly they fought, while the patient suffered.

Gradually the pendulum has settled its swing. Reason and judgment have come into their own. We no longer have to say, " We will not extract teeth," in order to distinguish ourselves from the ignorant or the unscrupulous. Public confidence is ours and we are free to give our unbiassed judgment. But make no mistake. Dentistry would not be where it is today but for the extremist who set themselves an impossible task and only partly failed through no fault of their own.

Not long after dentistry had become established as a profession there arose the problem of irregular teeth ; such a problem that men found it worthy of special study. And so was born a new science within a science, and it was called orthodontics, and such was the desperation of our ignorant forbears that many a crime was committed in its name. So presently a group of earnest and sincere men, fathered by one " Angle," the greatest of them all, banded themselves together in an honest endeavour to regularise their specialty. They said, " We will never extract a tooth. By these tokens shall ye know us from the common herd." The parallel continues. Angle and his men founded orthodontics as a real science, they raised that science to a pinnacle of excellence and prestige hitherto undreamed of, and they showed us what *can* be done. That they also showed us what *cannot* be done was yet another contribution to our learning, and is no reason why we in later years should feel superior. My respect for Angle and his work is such that I am inclined to take off my hat whenever his name is mentioned. And always that distinction from the common herd—" We will not extract a tooth !" This is still the creed of Angle's followers whom we might call the " Compleat Anglers," for they follow his teachings so literally that the master himself would probably be startled if he were here today.

In the opposite camp were men who, lacking Angle's skill, extracted teeth right and left, because they could find no other way to treat their cases. (Fools rushing in where Angle feared to tread.)

Their descendants are the " Stuff and Nonsense Brigade " of the present day. But there were also men who honestly believed that Angle was wrong, men who studied their subject and were sincere in their beliefs. Their cause was, and still is, sadly embarrassed by those who extract teeth in ignorance and who speak with noisy authority on a subject they have never taken the trouble to study.

It is time for the pendulum to settle its swing, and indeed there are already favourable signs. The difficulty of the situation is obvious. The " Complete Anglers " have built up a great tradition and they guard it jealously. They fear that once they admit the possibility of extraction as part of orthodontic treatment there may be a landslide towards the worst excesses, and the ignorant will rise in triumph brandishing their forceps. They fear that if they modify the foundation of their creed the whole structure built up during the last few heartbreaking decades might collapse like a pack of cards. Indeed, in the western hemisphere, people have been taught that the man who extracts a tooth is no orthodontist, is, in fact, little short of criminal, and in a land where 100 per cent is accepted as a standard minimum this was perhaps inevitable. An ideal has given rise to a form of snobbery, and it is indeed a tragedy when men of science have to close one half of their minds for any reason, however idealistic. However, we must be patient. The truth will emerge. The world, you will remember, remained flat long after it had been proved to be round.

The truth lies somewhere between the two extremes—on the one hand the view that no tooth should ever be extracted, and on the other the view that whenever treatment can be shortened or obviated by the extraction of teeth this should be done. Both views have something to be said for them and both are scientifically unsound. It is of the greatest importance to this generation of orthodontists that we should expunge from our minds all traces of bias in whatever direction it may lie, that we should be prepared to face facts and to seek only the truth ; in other words that we should be true scientists.

It seems to me that orthodontics is a study of the growth of the face with special reference to the teeth and jaws and their surrounding structures, whereby we seek to influence that growth towards normal development so that the end result is *normal for the individual*. An important factor in our treatment is the establishment where possible of normal occlusion of the teeth, but it is not the only factor, nor is it always possible. I would give special emphasis to the phrase *Normal for the Individual*. To take a standard or average normal and apply it to each individual is wrong, and may be disastrous. The standard normal should be our Guiding Star but not our Mecca. Frank Jackson of Philadelphia has said, " No individual conforms to an average except in so far as he contributes to that average." A truth so obvious is most likely continually to be forgotten. There can be little doubt that the special interdigitation of the teeth to which we refer as normal occlusion can, within certain small limits, be regarded as normal for all individuals according to Nature's original intention, but the relationship between the dental arches and the bones of the face and skull must vary so tremendously as to make normal occlusion at times impossible of achievement.

I submit that we tend to confine our attention too much to the teeth and dental arches. The very fact that we meet here to show each other models and to compliment each other on good " bench " results is sufficient proof of this. Those models mean nothing at all by themselves. They may, and often do, tell a completely misleading story.

Are we not approaching our problem from the wrong end. Already in our new-born wisdom we point a scornful finger at Angle because he made the first permanent molar a fixed point. Is it any less ridiculous that we assume that any part of the maxillary arch can be considered to be in normal relationship with the bones of the face and skull ?

In the mandible our province is clear cut. The whole jaw is our concern and we give our particular interest to its development. But in the maxilla we are inclined to confine our interest to the dental arch. Reference *is* made at times to the apical base, which I would describe as " the dental arch at apex level." This maxillary apical base, I contend, holds the secret of a large proportion of failures in orthodontic treatment. Our interest goes beyond that in an indefinite sort of way. We are concerned that the mouth-breather should be schooled to breathe normally through the nose, and we refer to the typical adenoid case, but our attention really is riveted on the teeth with only an occasional half glance at the structures above.

I believe that in our research we should concern ourselves with the growth and development of the whole face and that until we do so orthodontics will be an incomplete science. I venture to prophesy that in years to come those men who have concentrated their attention on muscle development will be remembered and honoured when most of our appliances, however ingenious, are forgotten.

Meanwhile we must be practical. We have the present situation to contend with, and we must be prepared to take a rational view of our limitations. I have reached an age now when I can review some of my work, and that of others, and can see that in some cases, with the loftiest of ideals, we have attempted the impossible.

The end result of a successful case must be equilibrium. If this is not attained the case will relapse partially or completely.

A large proportion of abnormalities are due primarily to developmental defects of bone in the maxilla. This must involve the whole " middle third " of the face, that is, all those structures except the mandible which lie below the skull itself. But to what extent the various parts of this complex structure are involved we cannot possibly tell. Therefore we have to ask ourselves how far we can guide and control the growth of this part of the face. In a negative way we can do something by removing interference with normal growth, and by establishing normal muscular habits at an early age—if we *see* the patient at an early age. But it is seldom that we are consulted before an abnormality is fully established, and rarely as early as we would wish. We are expected to correct abnormalities. Seldom are we given the opportunity to anticipate them.

It must be a patent fact that at times the disproportion in size between (*a*) the dental arch which would be required to accommodate all the teeth, and (*b*) the apical base, is so great that ideal

occlusion must give way in favour of equilibrium and harmony—the best, if you like, of a bad job.

It is important to acknowledge that at the moment we know little or nothing about the rate of bone growth of the middle third of the face, or whether it has regular periods of variable acceleration like the mandible. It may therefore be difficult or impossible to estimate, at the optimum time for intervention, to what extent the face and the apical base will grow.

When considering a case of normal or postnormal occlusion, therefore, we must ask ourselves the following questions :—

1. Within the limits of what we can do to influence the growth of the face is it possible to accommodate all the teeth within the maxillary arch, and produce a result which is both harmonious and stable, so that the mandible in correct occlusion will be in normal relationship with the face and skull ?

2. If teeth have to be removed in the maxilla is it possible then to accommodate the lower arch to the upper so that the mandible is normal to the face, remembering that teeth in the mandible can obstruct its forward movement just as much as can teeth in the maxilla ?

3. If not, is it necessary to remove in the mandible also and then in a postnormal case to proceed as if all the teeth were present ?

The latter, I submit, is the most difficult problem of them all, and one demanding courage. To extract four teeth in a postnormal case and then to face all the difficulties of intermaxillary traction without that snug interlocking occlusion at the end, which makes us feel so comfortably safe, is a big undertaking with nothing but ignominy as our portion if it fails. And yet I believe there are some cases in which this course is both right and necessary.

So often the removal of two upper premolars turns a Class II division 1 case into a Class II, division 2 case, imprisoning and forcing back the mandible, with all the attendant disadvantages to beauty and health which we have learnt from experience and from such investigators as P. G. Capon.* It is a solemn thought that our work may condemn a patient to indifferent health through oxygen starvation. In cases so treated I have many times seen evidence that the mandible has travelled forward to a small extent after completion. Such cases should be a warning to us.

I believe that in postnormal cases it is important to free the mandible and get it moving forward as early as possible in order to establish normal breathing and normal oxygen supply without which normal development of the " middle third " cannot proceed.

In mutilated cases we have additional problems, but it is important to study all the foregoing aspects of the case adding the extra problems which arise as the result of lost or misplaced permanent teeth.

The inevitable question arises what we are to do with the case in which circumstances of one kind or another render treatment impossible. I admit that it is a difficult problem, but it is rarely that one sees a case in which extractions without treatment can be anything but a useless sacrifice of teeth.

On the problem of extractions I will submit to you my views.

* Notes on Glossoptosis and Micrognathia—*Dental Record* LXVI, No. 3.

1. We should be unbiassed.

2. We should approach our work with the intention of conserving all the teeth if its is rationally possible to obtain a stable result. Experience shows that in a majority of unmutilated cases this is the only right form of treatment.

3. In cases where disproportion between facial development and size of teeth appears to render extraction necessary decision should usually be postponed until after treatment has commenced, especially in postnormal cases, when one is better able to assess the many factors involved.

4. Special attention should be given to the imprisonment of a postnormal mandible bearing in mind that the removal of teeth in the maxilla only may finally turn the key in the lock. In some cases the only alternative to conservative treatment may be the removal of four teeth—not two.

5. Before any such decision a careful study should be made of the development of the face and the placement of the mandible relative to the face and skull as well as to the upper arch of teeth.

6. I am not in favour of removing the six-year-old molar which plays an important part in the development of the jaws, and certainly not the removal of all four teeth as a panacea of all orthodontic evils. But in a case where one or more of the series is already lost or condemned we have a different problem, and we must take account of the influences, prenatal or postnatal, which have affected the development of all four teeth. In such cases if extractions have to be performed as part of orthodontic treatment these teeth must be considered.

7. In my opinion the removal of upper anterior teeth should not be considered under any circumstances. Whatever our personal opinion of the æsthetic result we have no right to jeopardise a child's happiness by making him or her look different from other people, even with the parents' permission. Suppose it were *your* child. That is the test. If such a tooth be already lost I would, wherever possible, advise maintenance of the space and later artificial restoration.

8. It would be ideal if all problems concerning the extraction of teeth were decided by committees of three experienced orthodontists, including, of course, the man in charge of the case.

REMOVABLE APPLIANCES AND NIGHT TREATMENT

Since it has been shown to be possible, the treatment of cases at night time only cannot fail to appeal stongly to our imagination and to our sense of what is right. Mr. O. Henry, just before the war, gave chapter and verse of the Vienna theory* which briefly amounts to this, that you may move a tooth or teeth with optimum ease for a limited number of hours. Beyond that period the propelling force meets with greater resistance due to some physiological reaction in the bone, which tends to increase if the force persists. Therefore, they say, tooth movement should take place during one third of the twenty-four hours, and the appliance be removed for the remaining period.

If it proves with further investigation and experience that all this is both true and practicable, then the next decade or so may see a complete revolution of our methods of orthodontic treatment.

* Modernised Expansion Plate worn at night only—*Dental Record*, LIX, No. 8 and LXIII, No. 11.

I propose as briefly as possible to give you the benefit of my experience so far as it has gone. First, perhaps, I should point out that I consider the theory that teeth should *not* be moved continuously to be so far unproven, but on the other hand the fact that they *can* be moved by intermittent treatment is a most important discovery.

Just before the war I had a long talk with Professor Schwarz about his methods and saw a large number of models of treated cases, which were most impressive. He admitted that by performing treatment in this way there is bound to be " relapse " during the void period, but claimed that this is only partial relapse and that some positive progress is made each day. It is not difficult to believe that this small amount of progress is more stable than the greater progress of continuous pressure, if only for the comforting reason that it has done most of its relapsing already. Any kind of removable appliance can, of course, be used in night treatment.

It has always been my opinion that normal function should be an adjunct to our treatment, and that Nature if given the chance will do a lot to help us. I believe, too, that we are all uneasily aware that in clamping a child's teeth throughout the twenty-four hours over a long period we may be interfering with normal development in one way while we try to stimulate it and guide it in another.

Since by the Vienna method it is necessary for active treatment to take place during only a part of the twenty-four hours,the advantages of using the period of sleep are obvious. The mouth is unencumbered during the day time, functionally and æsthetically, and there is no interference with speech and mastication. One can also use a type of appliance which would be intolerable during the day, a fact of which Andresen of Norway has taken full advantage. Already, for many years, we have experienced the beneficial effects of the oral screen, which not only promotes nasal breathing but has at times the most astonishing and gratifying effect in causing the movement of teeth and sometimes of the mandible itself. Whether the Vienna theory arose from the use of the oral screen I do not know, but it seems to me that our experience of this appliance might well have prompted us to think along these lines ourselves. I think we gave too much attention to the effect of the oral screen upon breathing and too little to its effect in re-establishing a normal balance of forces by reinforcing pressure in one direction and relieving it in another.

The orthodontist must be realist enough to face and take account of all the facts and circumstances which may affect his work, and I need hardly remind you that here in this country we have the dice loaded against us to an extent that would horrify our colleagues abroad. I will not tabulate our handicaps, which are known to you only too well, and of which our school system is perhaps the most serious. (Some of our children go to school so far away that our appliances are apt to be rattled to pieces before they get there.) But I will add one which is not so obvious but which specially concerns night treatment—I refer to family and school discipline.

I wish to make it clear that I am not proffering a special complaint against family discipline in this country. It is easy-going, pleasant and friendly, and perhaps provides the ideal atmosphere in which the child can develop its character freely and unrestrained-

ly, and on the whole our children are well-behaved. But it must be emphasised that this atmosphere cannot be compared with that of martial discipline which obtains in the average German home, any more than the characters of the children can be compared ; and these facts must be taken into account if we are preparing to adopt a form of treatment which has proved successful in Germany and Austria.

My experience of removable appliances is that most children will wear them obediently for the twenty-four hour period, and indeed soon find it uncomfortable to be without them, but as soon as you limit the time to the night period only you are liable to disappointment, and in some cases you begin to get poor results. It must be remembered that if the appliance is worn only at night it needs to be left out only one or two nights each week in order to neutralise what small progress has been made. To give you an idea how small this progress is, the ordinary Badcock screw, which is normally turned every second day, can be turned only once a week with night treatment. In other words, you have to choose your case. Curiously enough my experience has been that the Norwegian apparatus, the most formidable of all removable appliances, meets with more. success in this matter than any other. There are two possible reasons Firstly, its formidable nature makes it impossible for the child really to forget it—so you have only the rebellious rather than the forgetful patient offending. (It is not so much the child who was dropped on its head in infancy that needs watching, as the child who ought to have been dropped on its head.) Secondly, nearly all children with postnormal occlusion are positively interested in getting that chin forward. On the whole the greater the abnormality the greater the co-operation. This is a point worthy of consideration whatever form of appliance we are using.

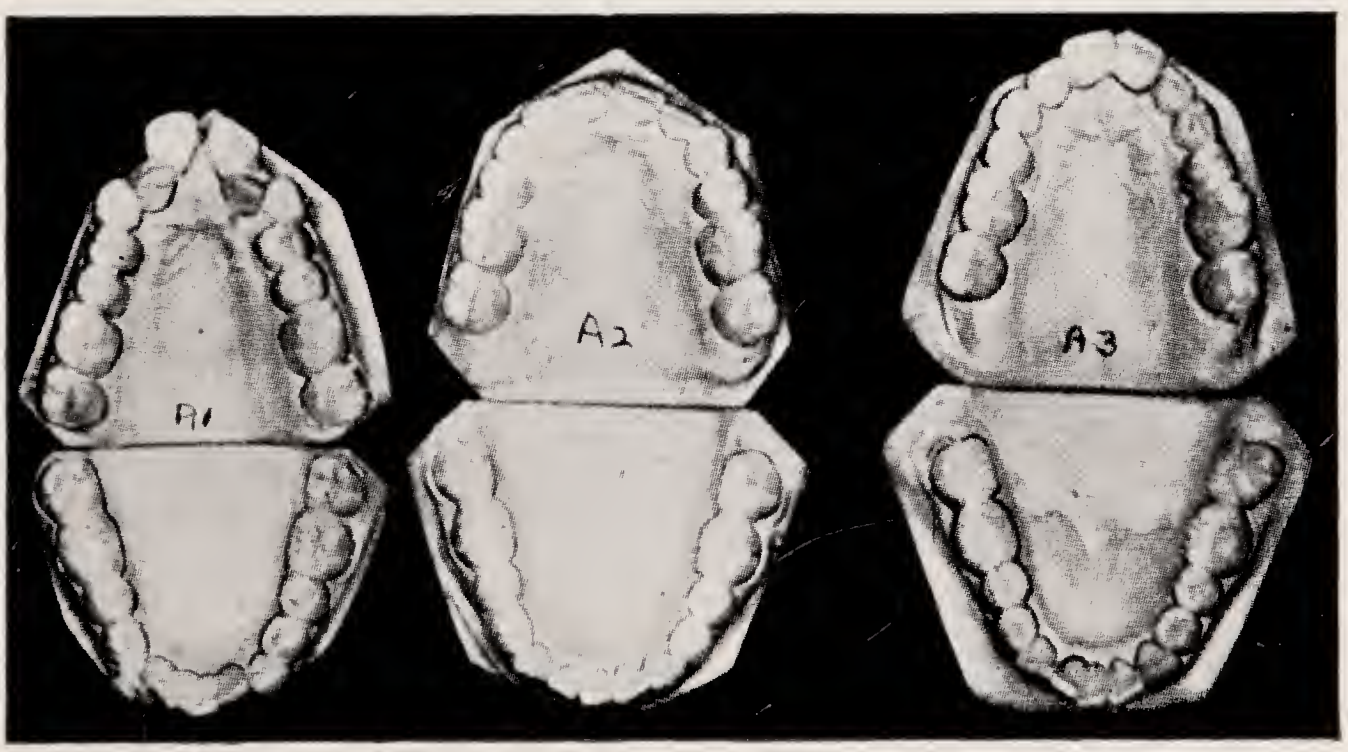
The war coming as it did within a month of my visit to Germany I have not been able to follow up my enquiries with the men who matter after acquiring personal experience, and I must confess that I am not yet convinced that night treatment is effective in all cases or for all patients, or even for all stages of the same case. I have therefore tended to add the new appliances and methods to my existing equipment, using them according to my judgment, rather than embrace a new therapy in its entirety. Professor Schwarz may not approve when he learns that I have been using his night appliance for the whole twenty-four hour period, but I have found it most effective. I refer to his apparatus which is designed to drive the cheek distally, one which has solved many a problem for me.

I do not propose to describe to you either this or the Andresen (Norwegian) apparatus, a specimen of each of which is here for your inspection.

The " Norwegian " is essentially an appliance for night wear, but its effect is increased if the patient can be induced to wear it during the day for an hour at a time, such as evening prep., when speech is not required. It is used for intermaxillary traction and is also effective in preventing mouth breathing. It is an unlovely, primitive-looking apparatus with positively no snob value whatsoever, and it is apt to be the object of derisive comment by colleagues who do not understand it. And yet a lot of care and trouble go into its making. It provides the only cheap and simple method of performing intermaxillary traction that is really effective.

The Schwarz apparatus, which, by the way, is often admired, is the only removable appliance I know which is really effective in moving molars distally. In this country, where the early loss of temporary teeth followed by misplacement forward of the molar teeth is more nearly the rule than the exception, it should be of inestimable value to others as it has been to me. Modified, it can be used in reverse to move forward the anterior teeth.

The following cases are not all dependent upon one type of apparatus or upon one form of treatment. The appliances have not necessarily been worn at night-time only, with the exception of the Norwegian apparatus for intermaxillary traction, which cannot be worn during the day. The cases are not all successful, but each, I think, has something to tell us.



Figs. 1, 2 *and* 3.

Case A. (Figs. 1, 2 and 3.)

A1. Original models, 1924—age 14.

A2. Completed case, 1927.

A3, 19 years later, 1946.

Treatment.—Duration two and half years. Both arches expanded. Upper first premolars and lower right central incisor removed. Canines retracted. Anterior teeth aligned. Expansion of upper arch 3mm.—relapse 1½mm. (this may be misleading as the upper second premolars have moved forward between A2 and A3 and rotated slightly).

Important observations. Although partial relapse is probably due to some extent to the removal of the lower incisor, there has been no collapse of upper and lower arches such as is seen when a lower incisor is removed at an earlier age. Today I would not take the risk.

Mandible has undoubtedly moved forward between A2 and A3 (since completion). This is clear from the lateral view, and proven by the decrease of overbite shown in the front view.

Lessons to be learned from this case are:

1. We cannot dictate finality in a case. After completion Nature takes a hand and produces her own result. Our job is to see that we attain an arrangement so near to equilibrium that the difference between our final and Nature's final is negligible. We can best do this by helping and making use of Nature's efforts during the course of treatment. Orthodontics is perhaps less a mechanical science than we think.

2. The tendency of a postnormal mandible to travel forward when released from "impaction," even after completion of a case, is both a warning and an encouragement. There are many cases where extractions are inevitable, together with and not instead of intermaxillary traction.

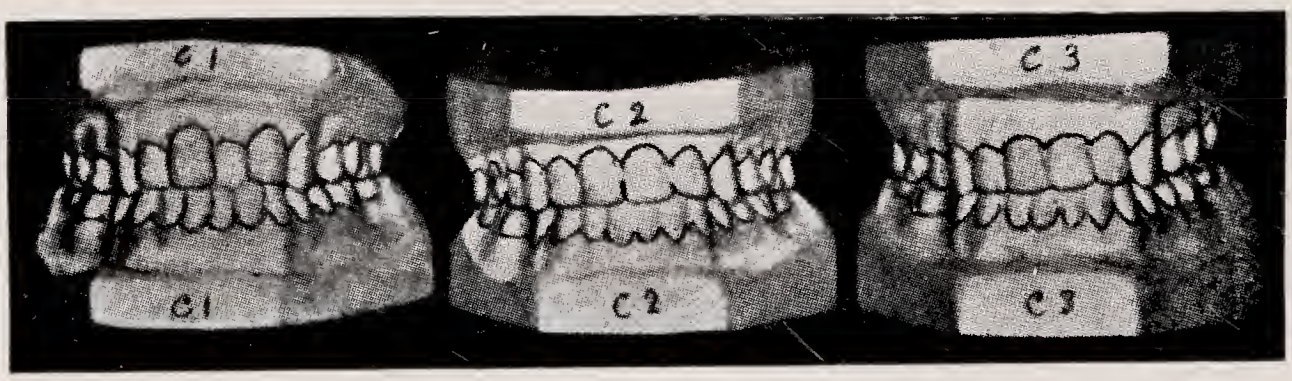


Fig. 4.

Case C. (Fig. 4.) Adult, aged 31. Condition: instanding central incisor, the upper first premolars having been removed on account of caries.

Treatment.—Duration eleven months. C1 to C2. Moved canines and lateral incisors to create a large space and then moved the central incisors into position (C2) by fixed appliance. Case then allowed to resolve itself (C3—twelve months later).

Points of interest. The ease with which space was made, and the difficulty of moving the offending tooth into position.

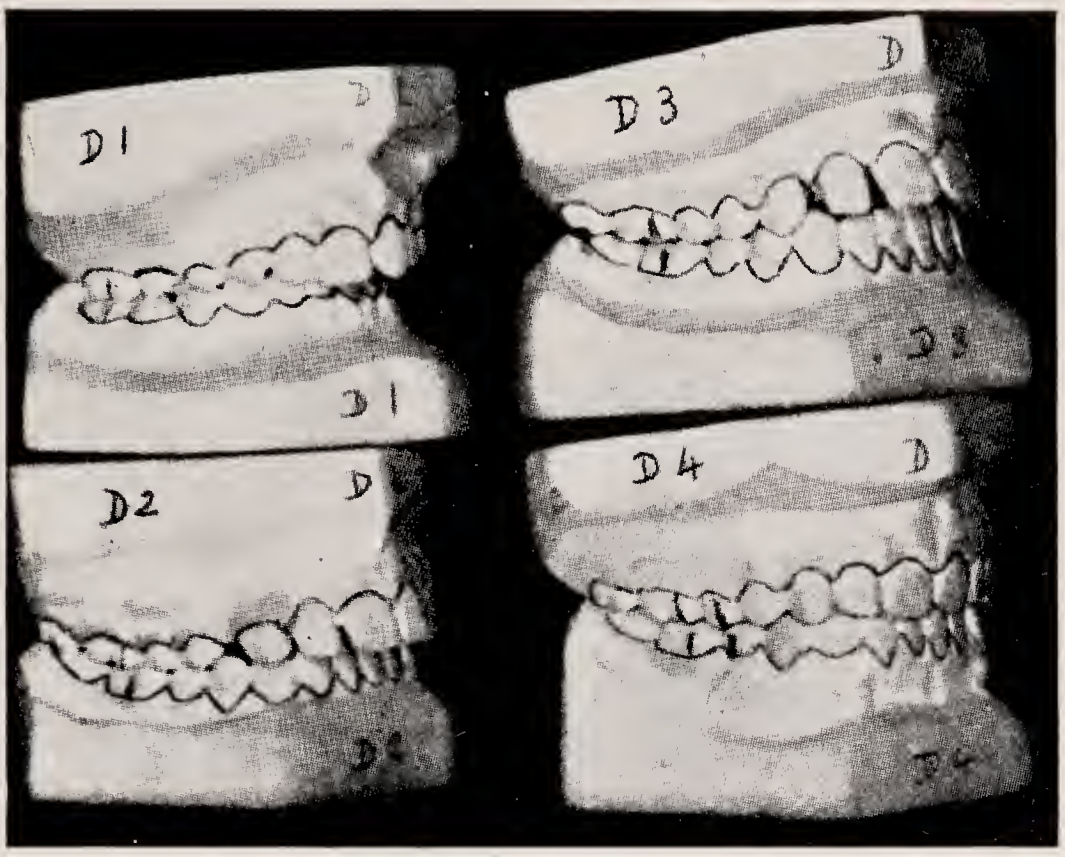


Fig. 5.

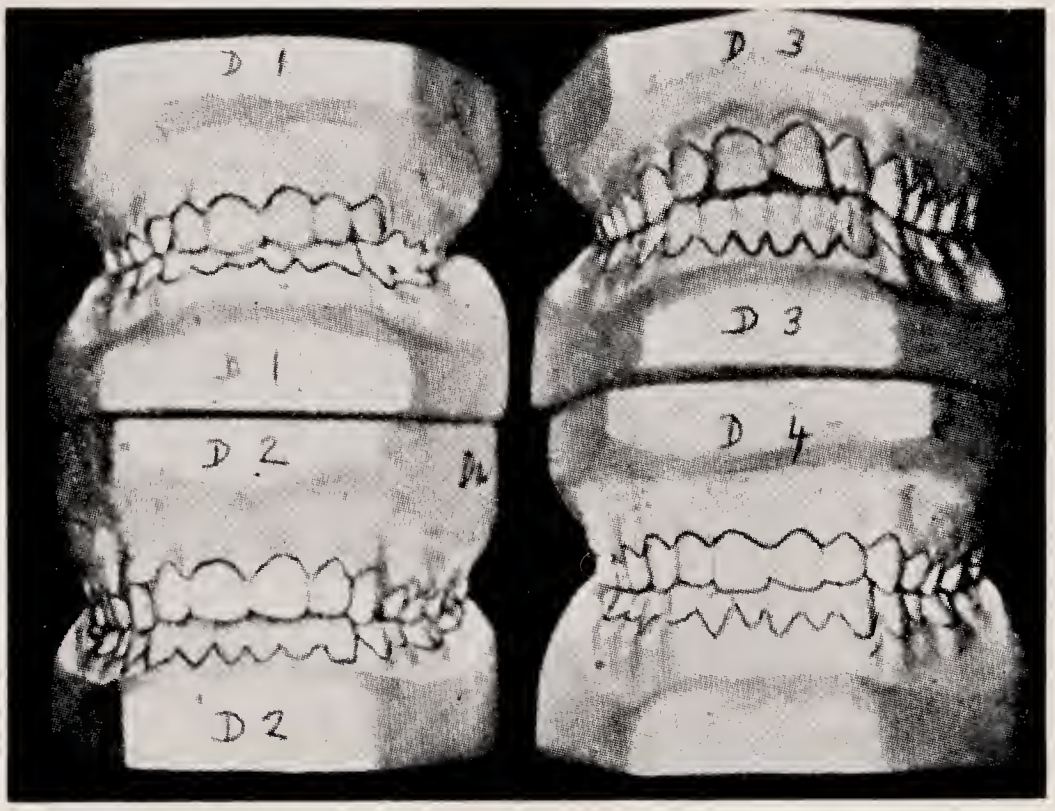


Fig. 6.

Case D. (Figs. 5 and 6.) Example of the distal movement of cheek teeth by means of the Schwarz apparatus, in four stages.

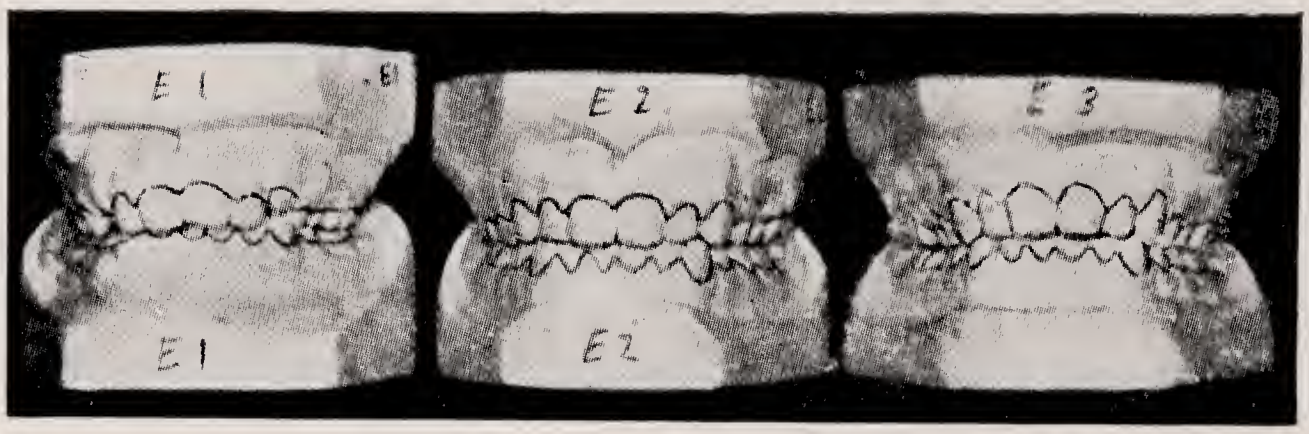
D1—Original condition—superior protrusion (of the whole maxillary arch) possibly associated with slight inferior retrognathism.

D2—Cheek teeth have been moved distally into normal occlusion, by means of the Schwarz apparatus (worn day and night).

D3—Upper canines moved into position by means of a removable apparatus of my own. Note that between D1 and D3 there has been a gradual movement forward of the upper anterior teeth which have been acting as part anchorage. This is unimportant (provided that the patient is reassured as is shown in

D4—where the incisors have finally been moved into correct occlusion.

Note.—Intermaxillary traction was not used in this case.



Figs. 7, 8 *and* 9.

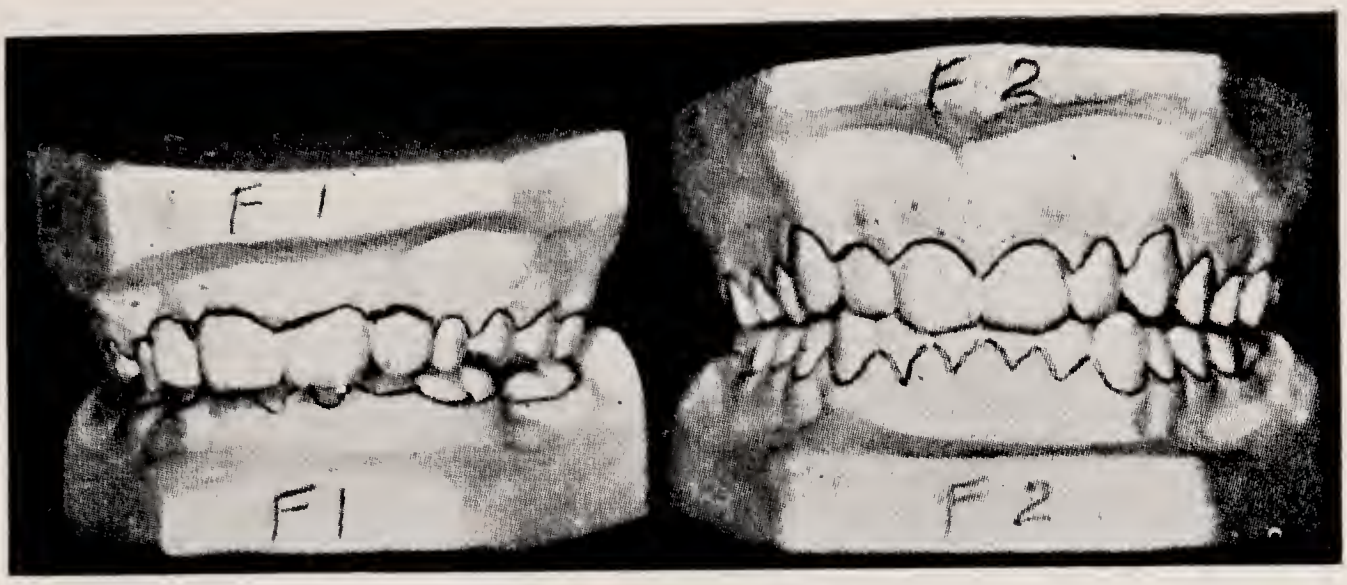
Case *E.* (Figs. 7, 8 and 9.) Shows success of Schwarz apparatus in making room for impacted lower premolars, and failure to establish the mandible in a forward position.

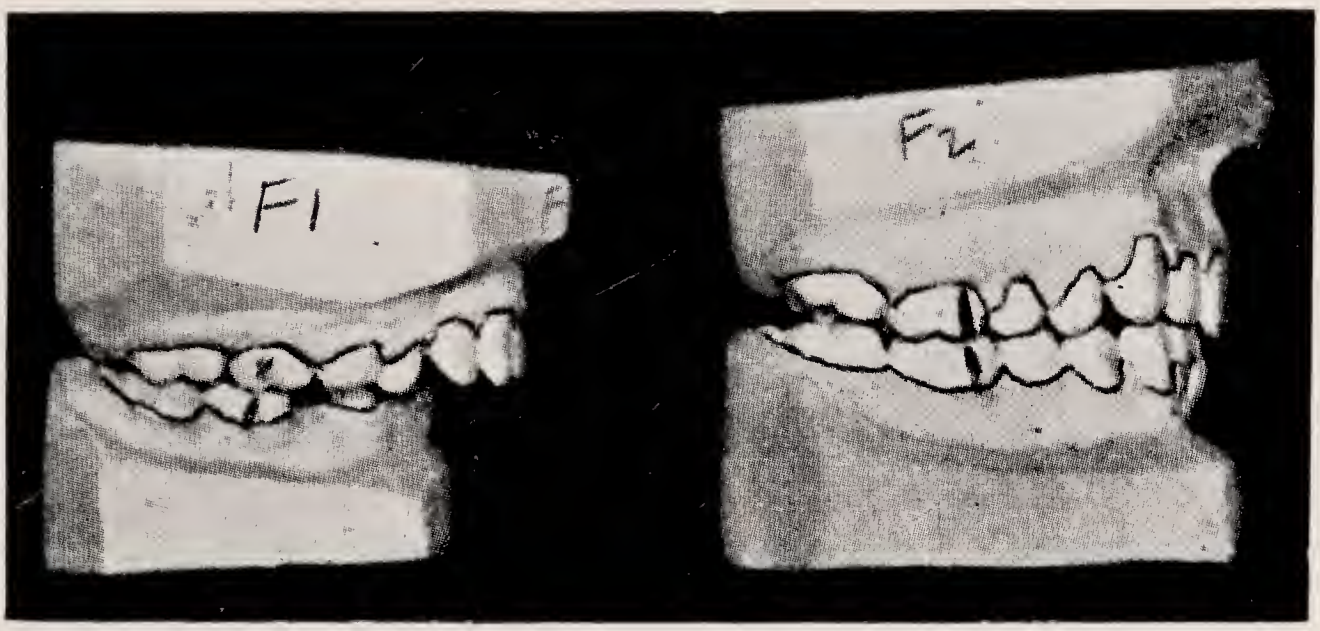
E1—original condition ;

E2—at this stage appliances were left out for some time and case relapsed to

E3—since when little progress has been made.

During the course of treatment I recommended the removal of two upper premolars, which the parents refused after taking other advice. The patient has small features and a well-developed chin, and it is possible that E3 represents the normal relationship between the mandible and the skull.



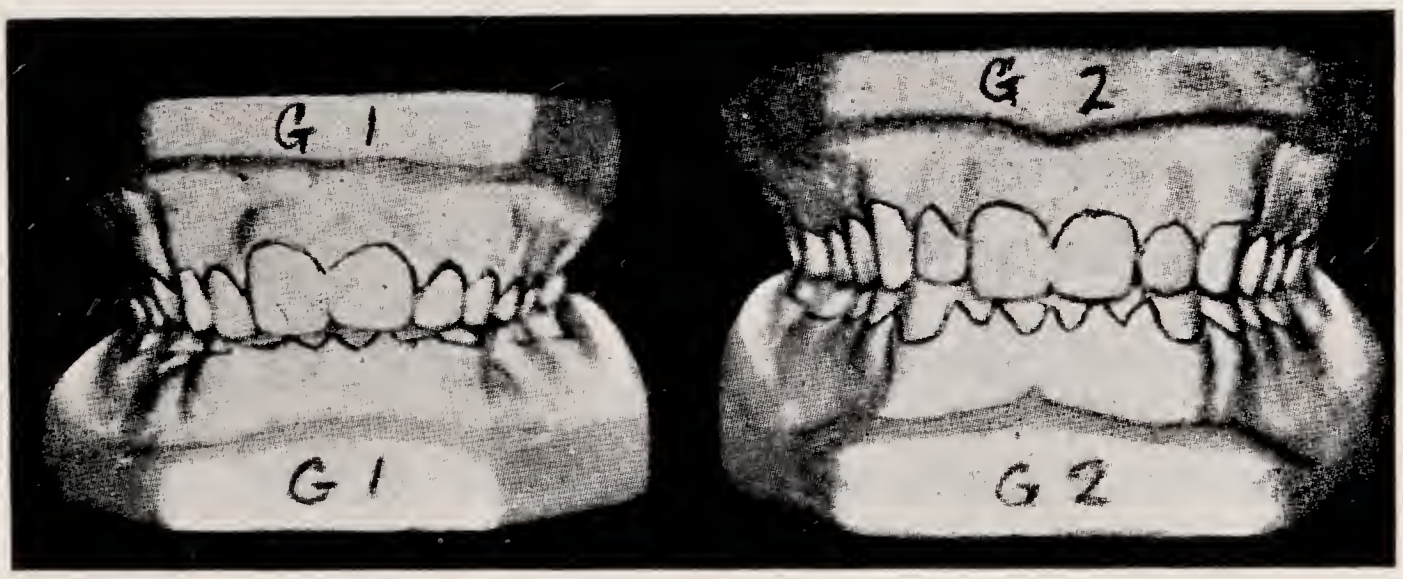


Figs. 10 *and* 11.

Case F. (Figs. 10 and 11.) (Brother of Case E.) Unlike the previous case, inferior retrognathism was obvious here.

Treatment.—Lower premolars freed with Schwarz appliance. Upper arch expanded. Traction of mandible by Norwegian appliance worn at night only.

Treated during the war the case is chiefly remarkable in view of the infrequent visits of the patient. Fixed appliance treatment was impossible. The mandible is now firmly forward.



Figs. 12.

Fig. 13.

Case G. (Figs. 12 and 13.) Angle's Class II, division 1 complicated by forward translation of lower first molars owing to early loss of temporary teeth.

G1—Original condition.

Forward movement of lower first molars gives a false appearance of arch relationship, the mandible being considerably more post-normal than it appears.

G2—Models taken two years after completion.

Treatment.—Lower posterior teeth moved distally by means of Schwarz apparatus. Upper arch expanded. Mandible moved forward by Norwegian apparatus worn at night time only. Case treated at long range with infrequent visits under difficult war conditions.

Case I. (Figs. 14, 15 and 16.) Angle's Class II, division 1 complicated by forward translation of upper first molars.

Treatment.—Distalm ovement of upper first molars (Schwarz apparatus). Expansion of maxillary arch. Norwegian apparatus worn at night to move mandible forward, fitted with long " Jackson" spring to retract upper incisors.

Note.—Astonishing improvement in health and morale as well as in appearance.

Case K. (Figs. 17 and 18.) This case is shown with the kind permission of Mr. Hubert Visick.

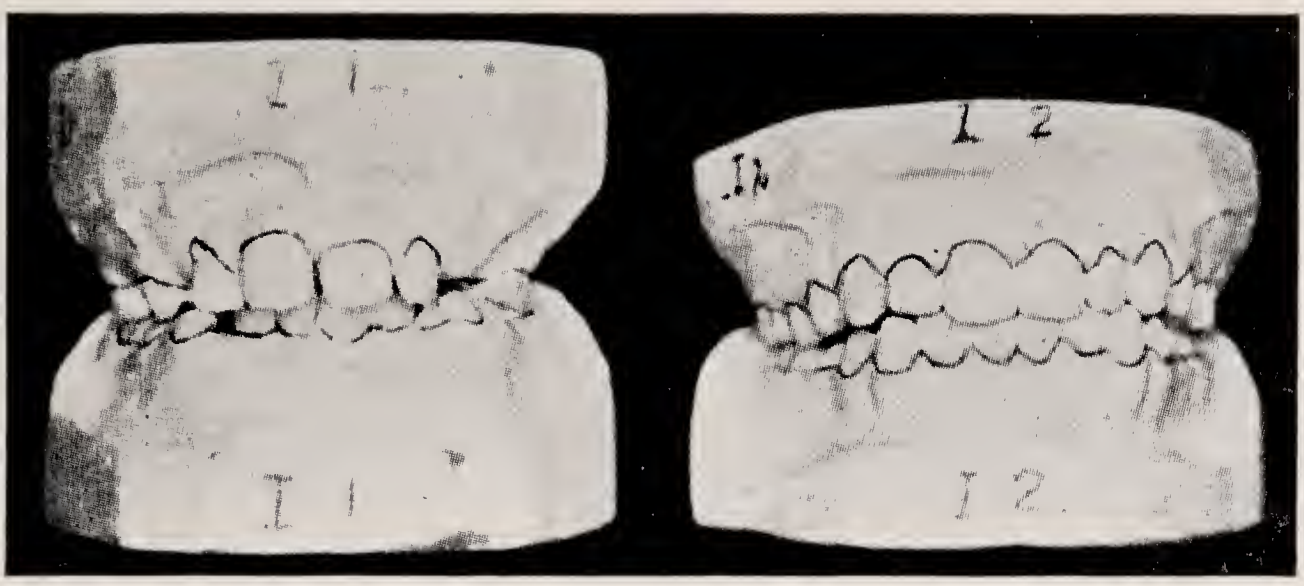
K1—Original condition. December 1940.

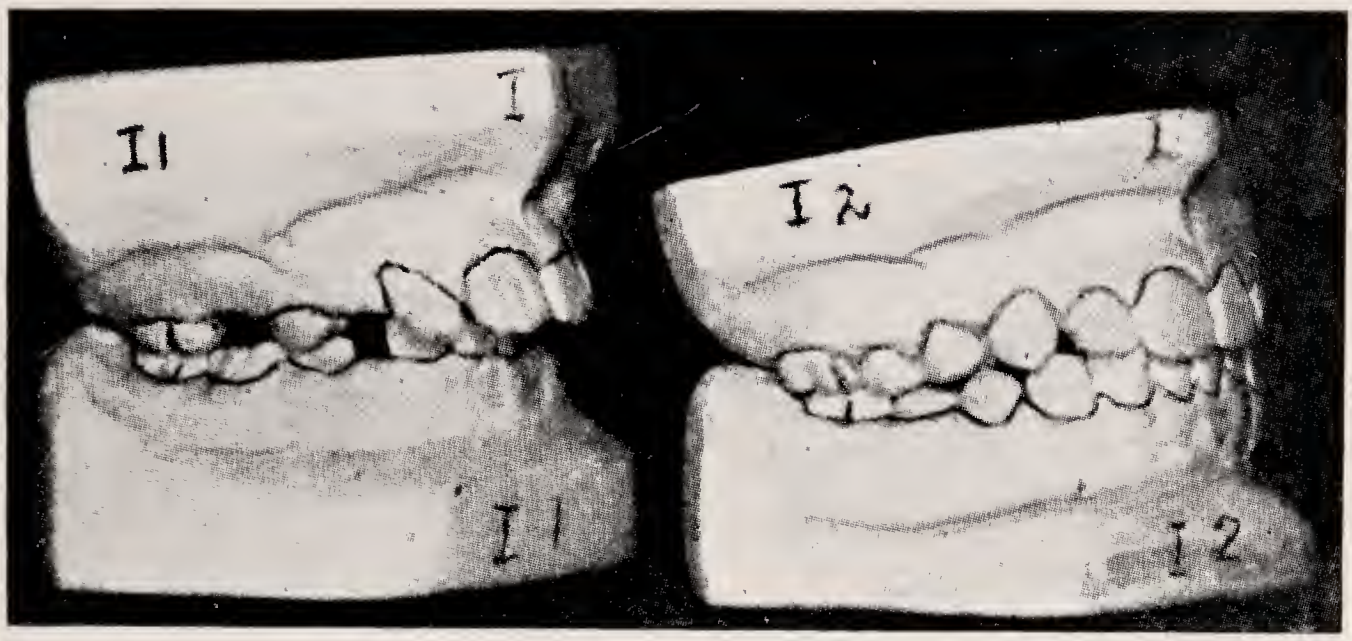
Treated by expansion of the upper arch, followed by traction with Norwegian apparatus.

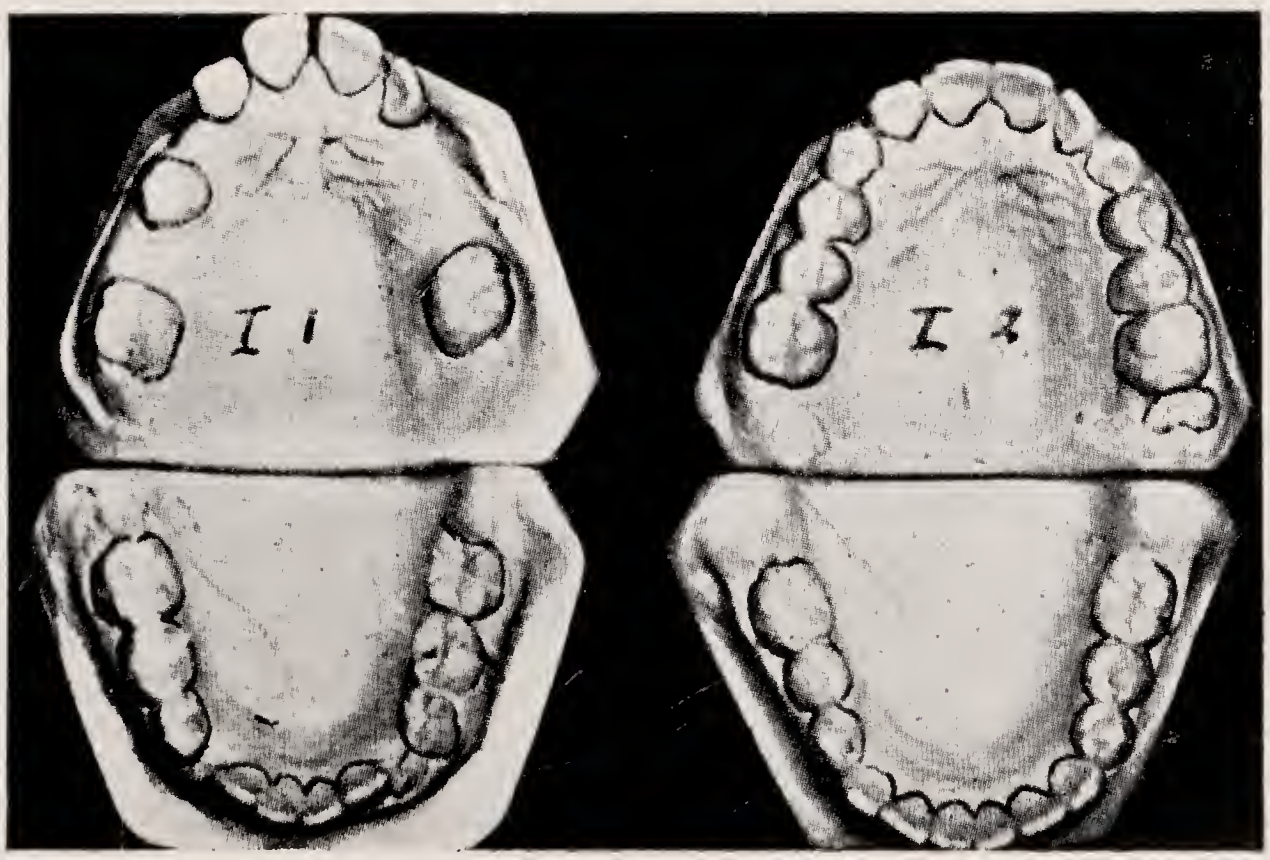
K2—November 1942.

After this stage the patient was without treatment or appliances for some months until she fortunately came into Mr. Visick's hands. By then the intermaxillary relationship had relapsed. Mr. Visick resumed treatment with the Norwegian apparatus.

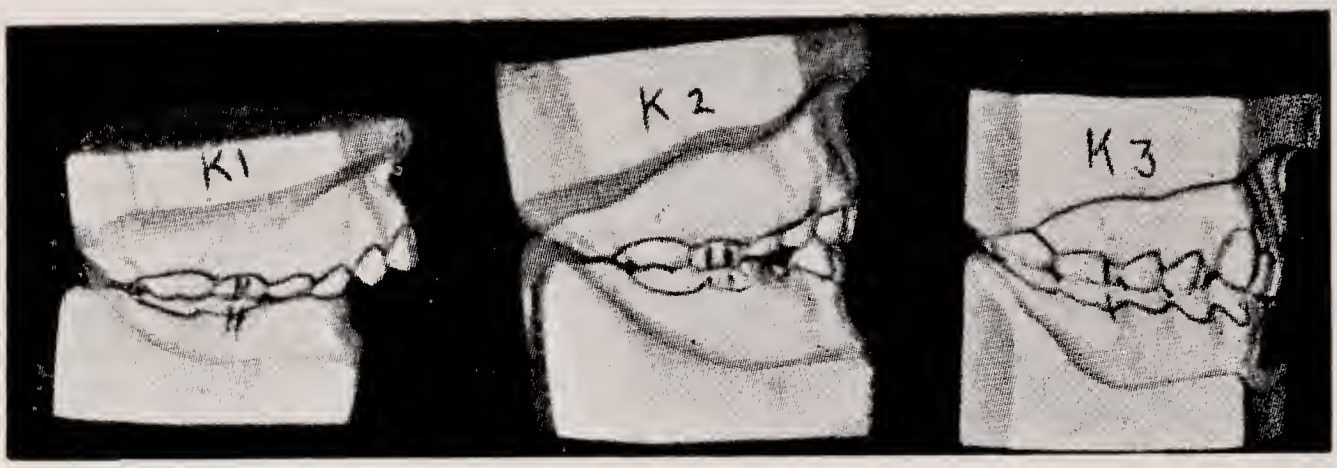
K3—Shows the condition a few months ago. During the intervening period the temporary teeth have been shed, and the canines are just coming into position.

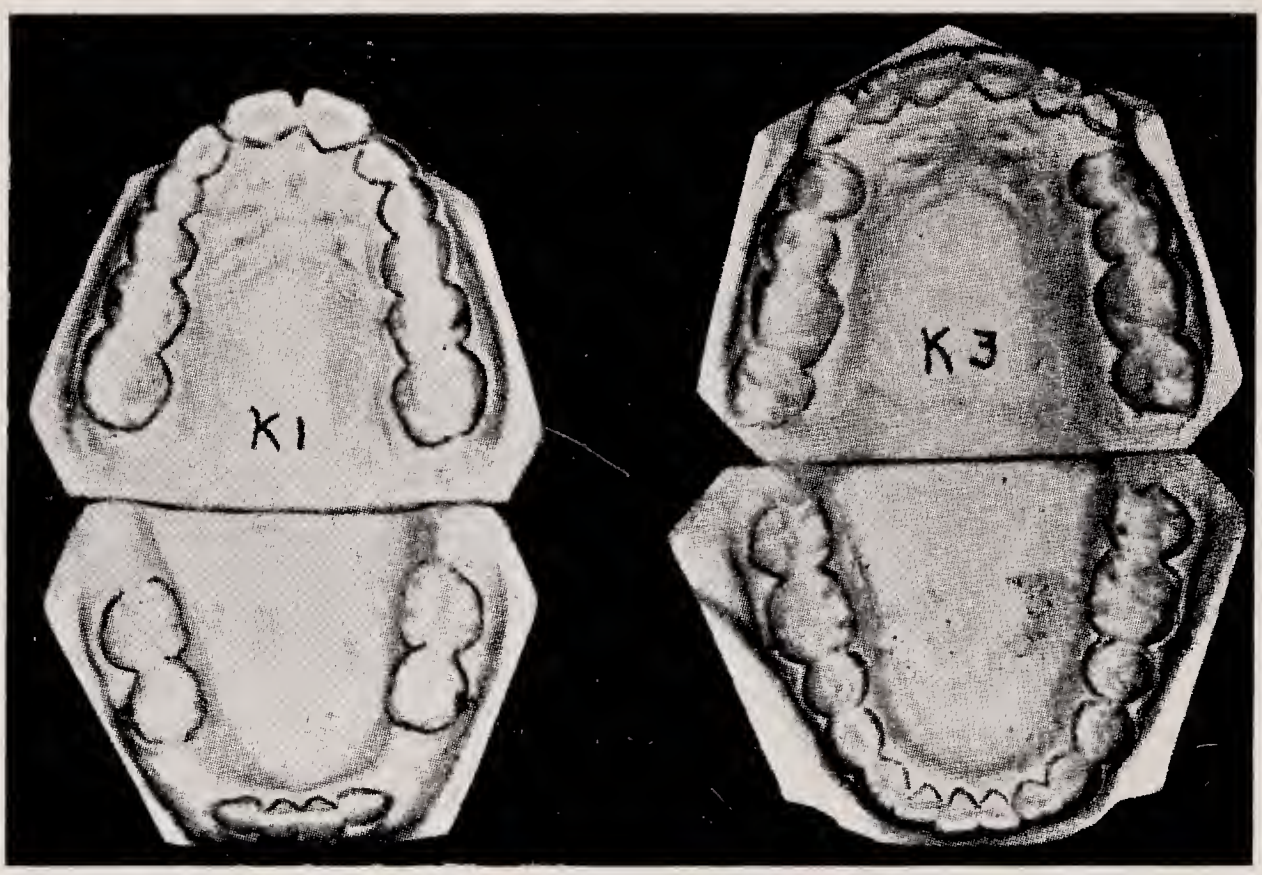




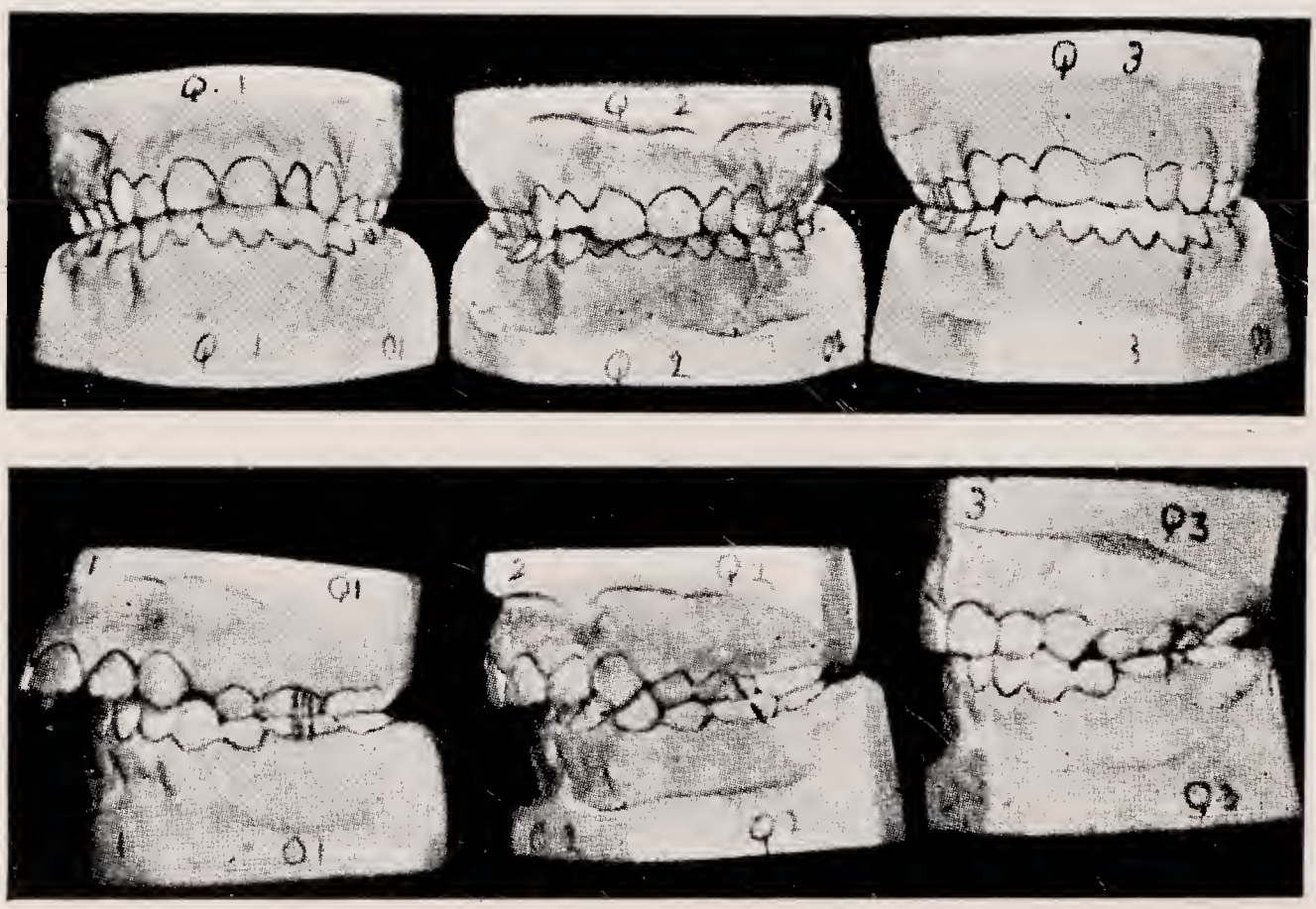


Figs. 14, 15 *and* 16.





Figs. 17 *and* 18.



Figs. 19 *and* 20.

Fig. 21.

Case Q. (Figs. 19, 20 and 21.) A bad Class II, division 1. Marked inferior retrognathism associated with extreme superior proclination of the upper incisors. Excessive overbite.

Q1—May 1933. Case presented with the two upper and two lower premolars already removed.

Q2—Upper canines and later upper incisors have been retracted. Intermaxillary traction with fixed appliances was then used and case completed in October 1935.

Q3.—Shows condition in May 1936, six months after removal of apparatus.

Note.—I believe that by accident two people between them hit upon the correct treatment for this case, the first seeking only to relieve crowding by extracting teeth, and the second having no choice but to make the best—as I thought—of a bad job. The result is instructive.

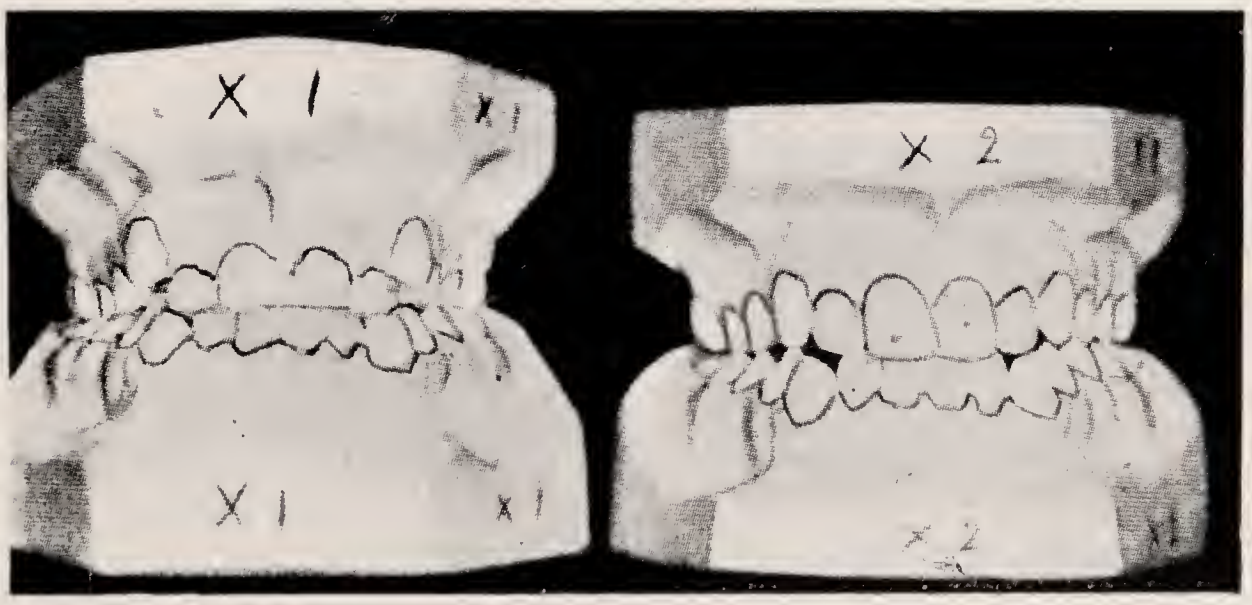


Fig. 22.

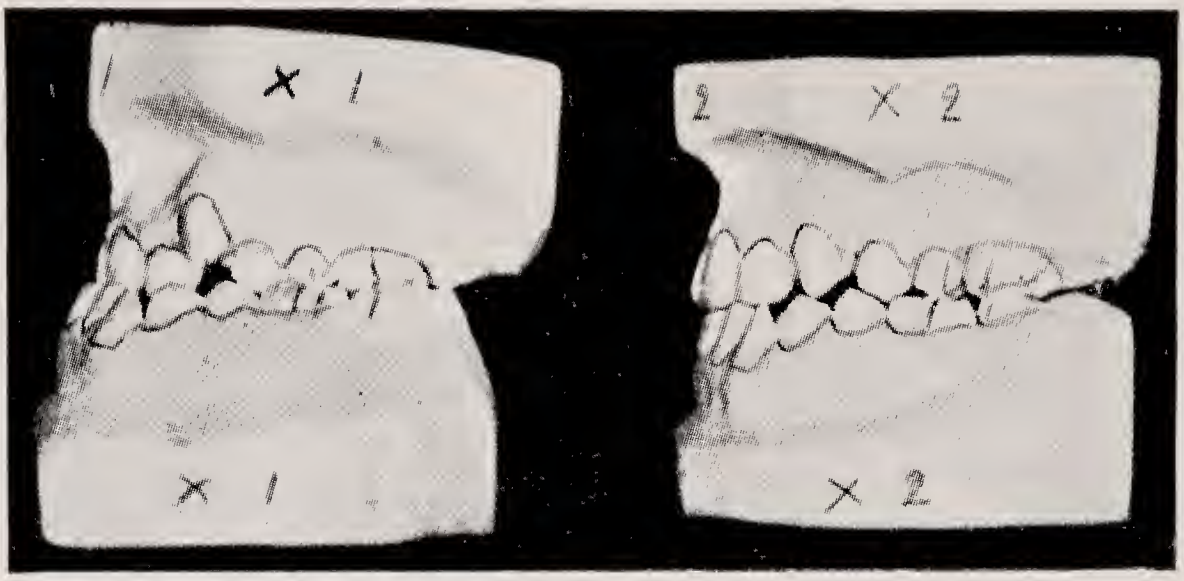


Fig. 23.

Case X. (Figs. 22 and 23.) This case, still under treatment, is instructive in that it shows what can be done in a short time with a Schwarz apparatus specially designed to move anterior teeth forward.

X1.—Original condition.

Normally the removable apparatus used for this purpose covers the premolar and molar teeth but not the anterior teeth. In this case I used clear Portex and capped also the four incisors so as to move the roots of these teeth as well as the crowns. The canine teeth were left free.

X2—Shows the case six months later. At this point no intermaxillary traction has been applied, and it will be seen that the molar relationship is the same. It appears, too, that the lower incisors have assumed a slightly more vertical position.

The case is not completed.

CONCLUSION

It is time that we were prepared to free our minds of all bias, prejudice and snobbery, whether it concerns the extraction of teeth, methods of treatment or types of appliance. Only so can we be honest with ourselves and with each other, so that we can all work together for the advancement of our science and the benefit of the patient.

Until we find means to promote normal growth of the middle third of the face and with it the apical base of the maxilla, we have to acknowledge the fact that there may be considerable disproportion in size between the apical base and the upper dental arch. This must not be ignored for the sake of an ideal. It is worthy of note that the early release of a postnormal mandible may be an essential factor in permitting free growth of the nasal passages, the sinuses and the whole middle third of the face.

Some of the postnormal cases we treat may be due in the first instance to delay in the forward movement of the mandible. It is possible that such delay may under certain conditions lead to or march with under-development of the maxillary arch which itself then becomes an obstruction.

If teeth have to be removed in the maxilla care must be taken that this does not restrict the forward development of the mandible. For this reason it may be necessary to consider the removal of teeth in both arches.

I believe that in most cases final decision on the extraction of teeth should not be taken until after the commencment of treatment, when judgment can be based upon some experience of the individual case.

As I get older I become more and more convinced that we are inclined to do too much to our cases. Our first concern should be to obviate any obstruction to normal function and give full freedom and encouragement to normal development.

The theory of night treatment and functional therapy is excellent, and where I have had full co-operation of the patient I have found it highly successful. But it is important, since this form of treatment has been proven in Central Europe, to remember the essential differences in home and school discipline here in this country. My experience is that our youngsters are willing but sometimes careless co-operators.

I sometimes start my cases full time and switch to night treatment when I think fit, not hesitating to switch back if I am not satisfied. I like to leave the mouth free during the day for as great a part of the treatment as I can. However, I have not deserted fixed appliance technique. I use it whenever I need for the whole or part of a treatment. There are, of course, certain tooth movements which are best performed with a fixed appliance and I use fixed intermaxillaries when I consider it necessary. But on the whole I have had most gratifying results with the Norwegian appliance.

It remains only to thank you for your patient attention and to congratulate those of you who are still awake on a remarkable feat of endurance.

* * *

Before reading his paper, **Mr. Marsh** *said: Two small boys were sitting together in a class room. They were both crying. One said to the other: "What are you crying for?" and the other replied: "I am crying because my plate hurts. What are you crying for?" "I am crying because my plate hurts too." So they changed plates and they were both comfortable and happy. One of those small boys was a patient of mine, and I have often wondered which of you made the other one's plate.*

DISCUSSION.

The President said the meeting had listened to a very interesting paper, enlivened with the humorous touches that were so characteristic of Mr. Marsh.

With regard to the postnormal occlusion cases in which the apical base was small and Mr. Marsh decided that it would be better to reduce the number of teeth in the mouth and then proceeded to take out two premolars above and two premolars below, would it not be wiser to institute intermaxillary traction first and then, having gone some way to correct the arch relationship, take out two premolars above and two premolars below ?

With regard to the question of respiration in postnormal occlusion cases, Mr. Marsh said there was some possible deficiency in oxygenation that was supposed to accompany postnormal occlusion cases. Would it not be that most Angle Class 2 Division 2 cases left nothing to be desired in the method of respiration ?

He was very interested in the excellent results obtained by the use of the Schwarz appliance and the Andresen appliance. The illustrations shown by Mr. Marsh were extraordinarily good and satisfying.

In the prenormal occlusion case which Mr. Marsh had shown, in which the four incisors, originally instanding, came over the bite rapidly, in two or three months, was the Schwarz appliarce used at night only or was the treatment continuous ?

Mr. Trevor Johnson said he would like to congratulate Mr. Marsh on his excellent paper.

He noticed that the appliances which Mr. Marsh used were made with rubber, and he would like to know whether it was pre-war rubber. He found that the modern rubber attacked the steel and he had been obliged to give up using it. Mr. Visick had told him that he had had the same experience.

He also noticed that in the lower appliance the screw looked a little different. Was it half a Badcock screw ? He gathered that the patient adjusted the appliance by turning the plate round rather than the screw.

With regard to the case shown by Mr. Marsh in which there had been forward movement of the mandible in the course of twenty years, could not that movement be due to attrition of teeth and be what happened in most cases ?

With reference to the distal movement of the molars, when a molar moved forwards due to premature loss did the roots move forward or was it only a tilting action ? If there was a forward movement of the roots, were they moved backwards by the appliance? If not, what happened to the roots?

Miss L. Clinch said she agreed with all that Mr. Marsh had said in his paper and she was particularly interested in his suggestion that there were cases in which it was necessary to remove four premolars. She had come to that conclusion herself, but only within about the last twelve months. She believed that, in post-normal occlusion cases, if the postnormal mandible was to be treated it was sometimes necessary to reduce the size of the lower arch, and, when a case was diagnosed as postnormal occlusion of the mandible, the postnormality should be cured. It often happened that a case was diagnosed as postnormal occlusion and nothing was done to the mandible. The upper six front teeth were retracted, and the postnormal mandible was left in its abnormal position.

In those cases in which Mr. Marsh moved back with a Schwarz appliance the molars which had drifted forwards, did he find that he obtained a better result in a child that was normal and robust than he obtained in a child that was weak and under-developed? According to Professor Friel, if a tooth was extracted the tooth in front of the space would cease to grow forward in the case of a weak and under-developed child, so that the orthodontists would be left not only with a molar which had drifted forward but also with a lack of growth in the front of the mouth, and that would have to be dealt with, as well as the distal movement of the molar.

Mr. H. G. Watkin said he would like to thank Mr. Marsh for his very instructive and interesting paper. Mr. Marsh's papers always gave the members something to think about, and the present paper was no exception to that rule.

Mr. Marsh had shown a very interesting X-ray of a case in which the 8's had started to regain a normal position after the extraction of the 7's and had said in his paper that it was a very good thing not to do too much too soon. He entirely agreed with that. He had had several cases in which the premolars had been almost horizontal, according to the X-ray. In such cases, if the obstruction was removed and the supervening deciduous molar taken out the premolars would assume a vertical axis, and, if left alone, they would become straighter in a few months.

He also agreed with Mr. Marsh's views about the extraction of first permanent molars. If they were healthy and could be saved it was often wrong to take them out, but, in the case of healthy mouths which were obviously going to be crowded between the ages of 12 and 16, it was a good practice to X-ray the 8 region and, if the 8's were present, to take out the 7's rather than the 6's. That overcame the trouble of the 8's being impacted, and they would come up. If the 8's were almost horizontal and the 7's were taken out, the 8's would come into position correctly.

He agreed with Mr. Marsh that laterals should not be extracted as a rule but that there were exceptions. There was one important factor to be considered in the matter. If the canines were of a flat shape, so that they could be made into laterals, it was possible that the case demanded the extraction of the laterals. He had recently had a case of a boy aged 14 or 15 ; someone had extracted the two first permanent molars in the lower arch but nothing in the upper arch, and there was tremendous protrusion. He had taken the laterals out, got the centrals right back and rotated the canines, and he thought that any of the members, standing two feet away, would have difficulty in seeing that the canines were not laterals. A very important point in this treatment was that the canines must be of such a shape that they were suitable for making into laterals.

With regard to the case shown by Mr. Marsh in which there had been an expansion of 3 mm., he thought that expansion would have occurred by normal growth, without any appliance being used.

He agreed with Mr. Marsh's opinion about the extraction of lower incisors. There was one small point that arose in that connection. After a postnormal case had been reduced, one side might be brought into normal relationship but not the other side, and there might be an edge to edge bite, but if there was more than a normal amount of overbite he thought the case could be left alone. The amount of distal occlusion in the lower arch was dependent to some extent on the amount of overbite. If there was a nice overbite in front, the lower incisor bite being lingual, normal relationship could be obtained on both sides. If the patient was too old for the bite to be raised and one side was normal and the other side not quite normal, that condition would remain stable, or it might be possible, if one lower incisor was extracted, to get both sides normal.

Mr. R. Cutler said he was sure everyone present would wish to congratulate Mr. Marsh on his paper. The preamble had been entertaining and instructive, and he hoped that the Editor would not delete it when the paper was published in the *Transactions*. It was very mortifying to the writer of a paper to find the preamble missing when the paper appeared in print.

One point in the paper which interested him was Mr. Marsh's inclination to avoid at all costs the removal of any one of the six

front teeth, on the ground that it was not a right and proper thing to do, because the teeth should be preserved, and also on the ground that the happiness and contentment of the patient might be disturbed thereby. Personally, when he saw a case in which there was a displacement of the teeth, if at the first glance at the case he had an instinctive feeling that he ought to take out the instanding teeth he believed that was the right thing to do, but, if the degree of displacement was such that he felt he ought to think twice about whether to remove the instanding teeth, he believed he would regret it if he did remove them.

He entirely disagreed with Mr. Marsh that as children grew up they were made unhappy by some abnormality or displacement of the teeth which fell short of gross abnormality. There were some children who became unhappy when they grew up, but they would become unhappy in any case, if not because of their teeth then for some other reason, such as having flat feet, which prevented them taking up dancing. He believed that, in the case of a really normal person, any discrepancy in the position of the teeth which fell short of gross abnormality did not in any way militate against perfect contentment. The exceptions to that rule were, he thought, very few and far between. He knew two very good-looking twin girls, about 20 years of age, one of whom had had an accident as a child, and, as a result, had to walk with a stick, one leg being a little shorter than the other. The two girls did everything together, and one could imagine the burden under which the lame one suffered in comparison with her twin sister, but that was an exceptional case, and he was not prepared to admit that any discontent or unhappiness was caused to a normal person by a dental abnormality which fell short of gross abnormality.

Mr. H. Chapman said he had been very interested in the cases which Mr. Marsh had shown and the excellent results obtained in all of them. He would especially congratulate Mr. Marsh on the first case he had shown, in which an excellent result was seen nineteen years after the completion of the treatment. In such cases it was important to recall the appliances that had been used and to see the present state of the gums and the alveolus, as information on those points was helpful in showing whether the treatment had been entirely beneficial.

That brought him to the question of the non-extraction of upper incisors. He was one of those who were not opposed to the removal of a lateral or even a central if they thought it would be beneficial. Mr. Marsh appeared to presuppose that if he did not remove a lateral, for instance, he could align the four incisors and they would remain in perfect alignment. But would they do so ? Mr. Marsh had not shown any case in support of that view. In the case, for instance, of a child of 13 with four upper incisors, one central being labial to the lateral and the other central, he quite agreed that those teeth could be aligned, but would they remain in alignment. If not, would the result be so good as it would be if a lateral was removed, in which case he thought it would be far more likely that the remaining incisors would be in good alignment ? It seemed to him that the effect was the criterion, and he would like to be shown some cases to support the view that non-extraction of an incisor produced as good a result as the extraction of an incisor. He did

not think that it did, because he found great difficulty in keeping in good alignment incisors which had started in malalignment.

He would be glad if Mr. Marsh could give a little more information about how his appliance affected development. Could he increase the size of the maxilla or the mandible ? He thought that it might be possible to change the shape of the bones, but he doubted whether their size could be increased to a greater extent than it would increase naturally. With regard to the case shown by Mr. Marsh in which there had been an expansion of 3 mm., could Mr. Marsh say how old the patient was ?

Mr. Marsh replied that the patient was $14\frac{1}{2}$ when she came to him and was nearly 17 when the treatment ended.

Mr. Chapman said in that case he thought Mr. Marsh was to be congratulated on having obtained an expansion which was not due to natural growth.

He would like to hear a little more about the oral screen, the effect it had on muscle action, and the benefit it conferred. It seemed to him that the lips were the oral screen and should be developed and that the child should be taught to use them as an oral screen. If the oral screen was used to move the teeth, that was another matter.

Was he correct in understanding Mr. Marsh to say that when he extracted four teeth he also expanded the arches at the same period. It seemed to him that expansion was not called for if extraction was part of the treatment, unless it was to widen the upper arch to fit the lower arch in its new position.

With regard to the case in which the upper incisors were lingual to the lowers, was that an Angle Class 3 case, and what was the age of the patient ? It did not seem to him to be a wrong course to adopt—in fact, he thought it was a good one—to shorten treatment and to avoid appliances. He could not believe that prolonged treatment was really beneficial.

He thought Mr. Marsh was to be congratulated on bringing out so many points which were of value to orthodontists in their daily work.

Mr. Hamish Anderson said that Mr. Marsh had referred to moving cheek teeth back. On many occasions when a cheek tooth came forward, particularly the six year old molar, it rotated. Did the appliance used by Mr. Marsh correct that rotation at the same time as it pushed the tooth back ?

Mr. Pedley asked Mr. Marsh whether his success with the Norwegian appliance had been confined to the type of cases he had shown that evening or whether he had had success with it in other types of cases, for instance, Class 3 cases. Also, did he get any individual tooth movement with the appliance, or did he confine its use to cases of postnormal occlusion and Class 2 Division I cases?

Miss R. Caseley, referring to the inferior protrusion case treated with a Schwarz plate, with the upper incisors capped, asked whether the plate was worn all the time, and, if so, whether it tended to reduce the overbite of the incisor teeth, so that there was less chance of retention. To what extent was the success of the Schwarz plate due to the fact that is action stimulated the deglutition of the patient and stimulated the muscles, bringing the tongue into the oral cavity ?

Mr. L. R. Marsh said he agreed with the President that intermaxillary traction should be tried before the four premolars were removed. As he had said in his paper, he did not think a decision on the question of removing the premolars should be taken until after treatment had commenced, and certainly in a case where there was any doubt about it at all one should try intermaxillary traction, for two reasons. First, during the course of treatment one might see an encouraging sign that further development would give more room for the teeth, and, secondly one could see all the factors involved in the case, not only the physical ones but also the type of patient one was dealing with, and whether the mandible would come forward to the desired position in relation to the upper arch as it was at the moment. One could then decide whether to remove the four premolars or not.

With regard to respiration in Angle Class 2 Division 2 cases, he believed that the amount of postnormality was far greater in most Class 2 Division 1 cases than it was in Class 2 Division 2 cases, and he doubted whether respiration was badly interfered with in Class 2 Division 2 cases.

In the prenormal occlusion case to which the President had referred the child wore the appliance night and day. If the appliance had been worn at night only, the progress made would have been considerably slower than had in fact been the case.

In reply to Miss Caseley's question whether the wearing of the Schwarz appliance capping the teeth affected the overbite, he would say that he did not think it would, because all the teeth were in occlusion, except the anterior teeth, which were slightly apart, even with the appliance present.

With regard to Mr. Trevor Johnson's remarks, he had a good many accidents with his appliance, and that was probably due to the bad rubber to which Mr. Trevor Johnson had referred.

As to the lower screw which Mr. Trevor Johnson mentioned, it was an ordinary Badcock screw such as was used for the lower—the smaller type. In Germany a type of screw was used by which the two halves of the plate were revolved, the disadvantage being that one complete thread had to be turned each time. It was a rather unbalanced sort of apparatus, and it seemed to him that the child was liable to wind the plate back without realising that it was going back. He thought the apparatus used in this country, with a quarter turn, was a very much more stable apparatus.

With regard to Mr. Trevor Johnson's question whether, in the case to which he referred, attrition would have caused the locking of the bite later on, it was particularly significant that the overbite was less deep now than it had been twenty years ago. That was rather against the idea of attrition and convinced him that the mandible had moved forward.

He thought there was no doubt that when six year old molars moved forward into a space created by the removal of a temporary tooth they tilted forward, and that was why they could be tilted back again fairly easily.

He had a great respect for Miss Clinch's judgment, and he was very glad she agreed with him about the removal of four premolars, because he knew she was opposed to the removal of any tooth that could properly be saved.

He agreed with Miss Clinch that postnormality must always be treated and that extractions should not take the place of treating postnormality when there was any possibility of getting the mandible forward.

He had not noticed that the Schwarz appliance was more successful when the patient was robust, but he had noticed that there was a variable response, and he had sometimes wondered why results were better in one individual than another. One could never be quite sure about co-operation.

Mr. Watkin had referred to nearly horizontal and impacted premolars. He had a case at the moment of a badly impacted second premolar. He had removed the tooth above it and with a Schwarz plate he had moved the six year old molar back as far as he dared, leaving ample space. He found Mr. Watkin's remarks on the subject encouraging.

Mr. Watkin had also mentioned the question of the removal of 7's rather than 6's in orthodontic cases. He thought it was necessary to be very careful of the erupting 8, because most children who had suffered from crowded mouths, especially when they had been treated by conservative methods, had impacted wisdom teeth. Those should be watched and dealt with early, as otherwise the cases were later on liable to relapse.

With regard to the case of expansion to which Mr. Watkin had referred, he was sorry to hear that Mr. Watkin thought the treatment had been unnecessary and that the expansion would have occurred naturally, because the case was the first one that he had treated in practice. The patient now had one child, and the child was in exactly the same condition as the patient had been in herself.

With regard to different degrees of overbite in different cases, he believed there were certain cases which orthodontists should be very cautious in treating, and one was the case in which there was extreme postnormality but a normal overbite, because one could treat that and produce an open bite in the end.

As to Mr. Cutler's remarks, he might say that he had intended to delete the preamble himself.

He felt very strongly on the question of front teeth, and he did not think it was possible to assess what affected people's happiness and what did not. If an abnormality of the teeth affected a child's happiness it might be a very serious effect indeed.

With regard to Mr. Chapman's question about the condition of the patient's gums in the first case he had shown, he did not think they were quite normal for a patient of her age, but one seldom saw normal gums in these days.

Mr. Chapman wished to see a case in which the front teeth had been lined up. Surely the first case he had shown was such a case. The laterals were instanding, the centrals were standing right up forward, and the canines were more or less impacted, but the teeth had lined up very successfully, with no particular trouble or skill on his part, by the removal of the two first premolars. There might be cases in which it was impossible to align the front teeth, but he thought they were exceptional.

He did not claim that the appliances to which he had referred in his paper effected development, but he did claim that they tended to allow development in cases in which possibly without appliances the development would be restricted.

With regard to the oral screen, he had had one case in which there was severe protrusion and in which he had seriously considered removing two upper teeth. The patient wore an ordinary oral screen for a time, and the central incisors began to fall back into place and the mandible began to come forward in such a startling fashion that he changed his ideas about treatment altogether.

In the Class 3 case, the age of the patient was 14.

With regard to Mr. Anderson's question about the Schwarz appliance and the rotating six year old molar, he had not had many cases of badly rotating six year old molars to deal with, but he thought the appliance would act favourably in such cases. If a rotating six year old molar came forward and was pushed back into its normal position by means of an appliance which did not clamp it too hard, it was probable that it would travel back in the same path as that in which it had travelled forward, so it was very likely that it would be de-rotated. If not, one would have to use a fixed appliance.

Unfortunately the Norwegian appliance could not be used effectively in a Class 3 case. The principle of the Norwegian appliance was that the jaws were articulated in the forward position and then a double plate was made. The plate was in fact an upper and lower stuck together. If one started with a postnormal mandible, one took a wax bite with the jaws in the position one wanted, or even a little more forward than the normal, and with the jaws slightly apart. Then on an articulator the appliance was made, it being in fact two plates stuck together. That could not be used in reverse, because a prenormal mandible could not be put back to the right position for the purpose. The appliance could be used to retract lower incisors by means of springs. He had been trying to devise an appliance that would do for a Class 3 case, the idea being to have the two plates which were stuck together in the Norwegian appliance separated and running on rollers or in tubes or in some way attached to one another with some sort of traction in between.

In reply to Miss Caseley's question, in the case to which she had referred the plate was worn all the time.

On the motion of the President, a vote of thanks was accorded to Mr. Marsh for his paper.

* * *

DEMONSTRATION MEETING

MUSEUM SPECIMENS

By Miss LILAH CLINCH, L.D.S. (Irel.)

Additions to the Museum were shown demonstrating the Morphological Classification of the Variations and Modifications of the Positions of the Teeth in Man outlined by Dr. Northcroft. (B.S.S.O. Transaction, 1935.) Also serial models :—

(*a*) from birth to 7 years.
Presented by Dr. J. H. Sillman.

(*b*) from 4 years to 23 years.
Presented by Professor Sheldon Friel.

(*c*) from 3 years, 9 months to 15 years. Showing delayed vertical alveolar growth.
Presented by Mr. P. G. Capon.

* * *

ITEMS OF INTEREST

E. R. COOPER, L.D.S. (Edin.)

A method of treating cases of post-normal occlusion was shown where molar anchorage has been lost, and where early treatment is indicated.

Models of the teeth are mounted on articulators with the distal position of the mandible corrected by means of a wax ' bite.' This wax bite is obtained by allowing the patient to occlude in the desired position on the wax which has been previously adapted to one of the models.

Allowance is made for muscle relaxation during sleep by slightly opening the bite on the articulators.

An oral screen is then fitted to the models carrying a lingual wire bow of 1.0 mm. in diameter, which is made to impinge on the lingual surfaces of the lower incisors near to the gum margin, being inserted into the oral screen just behind the upper canine teeth. The oral screen itself is adapted to the labial and buccal aspect of the upper and lower teeth, reaching to about the position of the second molars, which may be just erupting, and as far as possible into the sulci of the maxilla and mandible.

It should not fit too closely in the molar and premolar regions. By means of the lingual bow, the mandible is held in the forward position and a certain amount of backward pressure is transmitted to the upper teeth.

This backward pressure can be easily increased by the incorporation of a rubber ring of suitable size, two ends of which emerge from the lingual aspect of the oral screen in the region of the upper canine and looped together by 0.7 mm. wire bent at each end. Only slight pressure is indicated.

Thus, this appliance can overcome or at least minimise the effect of muscle imbalance, such as the impingement of the lower lip on the lingual aspect of the upper incisors, and at the same time encourage the correction of post normal occlusion.

Models of a case were shown which exhibited a marked improvement after six months, the patient wearing the appliance only at night.

This method is not quite original. It is an adaptation of the principles of the Andresen system and the lingual technique of Oliver, Irish and Wood.

* * *

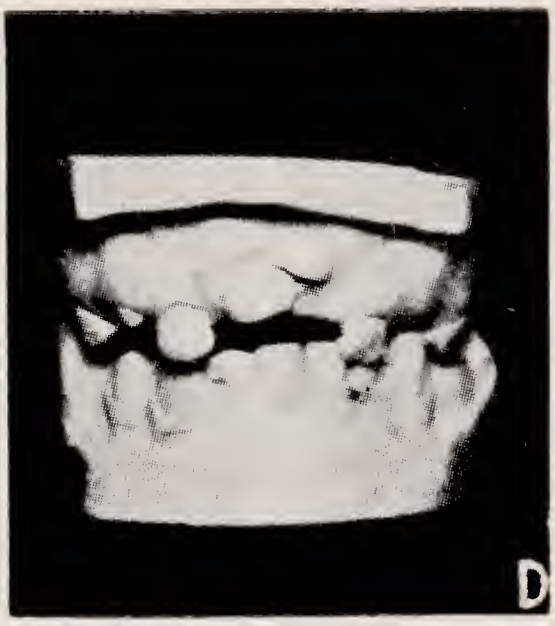
UNERUPTED TEETH WHICH HAVE BEEN SURGICALLY EXPOSED AND BROUGHT INTO OCCLUSION

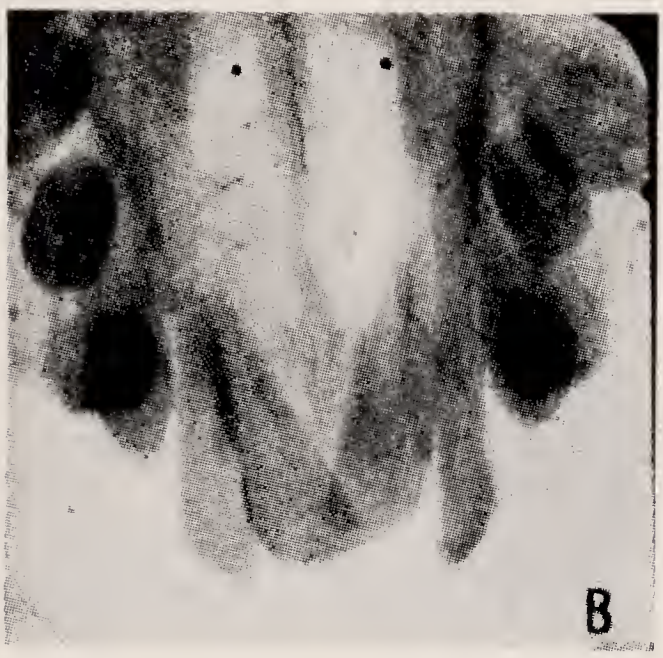
By A. J. WALPOLE DAY, H.D.D., L.D.S.

TEETH WHICH have failed to erupt for one reason or another have far too long been regarded by the majority of the dental profession as a problem for surgical extraction instead of a problem for the orthodontist. Most dental surgeons must at one time or another have removed the gum over a premolar tooth which was having a difficult time in erupting, but few have done the same for a buried incisor tooth.

The four cases described in this article are chosen from a series of cases in which experimental treatment was given to unerupted teeth in order to bring them into occlusion.

The first experiments were designed to ascertain if, when all obstruction was removed, an unerupted tooth would erupt into its normal position, or if not into its normal position into such a position that it would be a simple orthodontic procedure to bring it into line. It is of course obvious that if the unerupted tooth is grossly misplaced, such as in the case of a canine tooth lying in the palate, that mechanical as well as surgical treatment would be required. It was decided, therefore, that the first cases to be treated should be those in which the unerupted teeth were in such a position that eruption along the line of the axis of the tooth would bring it into a reasonable position. The first case treated was ideal in this respect. The child, a girl aged nine, had a retained $\underline{|A}$ and $\underline{|1}$ unerupted. The X-ray showed the $\underline{|A}$ in position with a supernumerary immediately above it and the $\underline{|1}$ immediately above the supernumerary. The exact position of these teeth was verified by taking X-rays from various angles. Under a local anæsthetic, an incision was made and a flap of muco-periosteum reflected, the $\underline{|A}$ and the supernumerary were removed and the tissue around the buried $\underline{|1}$ explored. The tissue in the immediate vicinity of the crown of the $\underline{|1}$ was cut away with some bone and the flap of muco-periosteum was then stitched back into position except for a small piece which was removed so that the crown of $\underline{|1}$ should remain exposed. This aperture was then packed with B.I.P.P. gauze to prevent the gum healing over again. This, how-





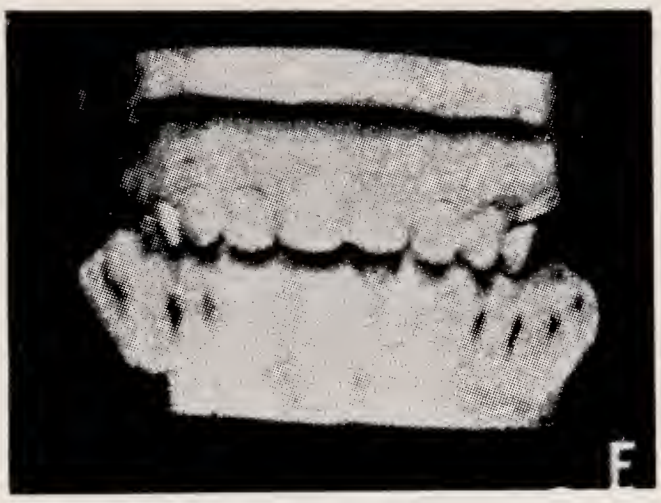


Fig. 1. (*R.F.*)

A. *January*, 1939.
B. *February*, 1940.
C. *March*, 1941.
D. *March*, 1940.
E. *October*, 1942.

ever, was not completely successful and the crown of |1 had to be exposed again six months later to facilitate eruption. After two years from the initial operation, the tooth was in position, but crossed over 1| and this was subsequently corrected by an appliance.

The next case that was treated in this way and which is illustrated in this article was a boy, R.F., aged nine years with two unerupted upper central incisors and two unerupted supernumeraries. This case was treated in exactly the same way and followed the same course except that mechanical aid was given to help the eruption of the teeth after a wait of only fifteen months.

Several similar cases have been treated in the same way, all with good results ; the technique was modified slightly in the later cases, but only in details. It was found that zinc oxide and oil of cloves

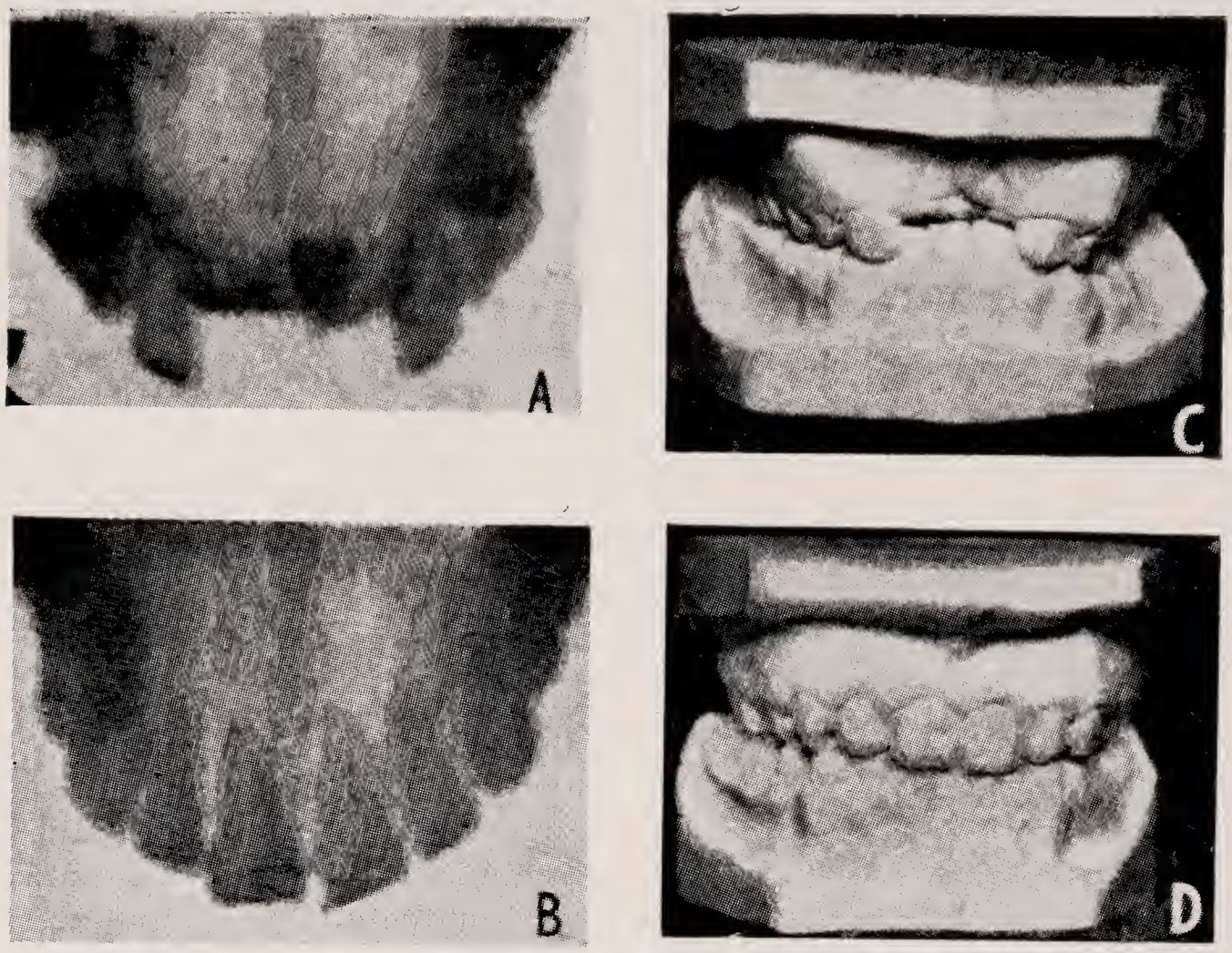


Fig. 2 (*P.B.*)
A. September 1942. *B. April*, 1946. *C. November* 1942. *D. November* 1945.

into which a little wool was incorporated, was a more satisfactory dressing than B.I.P.P. which was easily washed away, and it was also found that the removal of bone around the crown of the unerupted tooth, helped to speed the process of eruption.

At first, the rate of eruption is quite rapid, but it gradually slows down. In the younger patients it is possible that complete eruption would take three years, but in the older patients it is doubtful if the unerupted tooth would ever completely erupt without mechanical assistance.

The fact that the teeth erupt at all is of great help in treatment, because it is possible to put a band or cap on to a partially erupted tooth and thereby bring it into occlusion, which technique is always preferable to drilling a hole into the tooth and attaching a ring to it.

The success achieved with unerupted incisor teeth naturally led on to the problem of the unerupted canine in the palate.

Here was essentially the same problem, but with a big difference. As the direction of eruption was along the line of the long axis of the tooth, merely exposing the crown portion of a canine tooth lying horizontally in the palate would not be beneficial and the gum would eventually heal over the unerupted tooth if some means to prevent this were not employed.

The cause of the canine in the palate is not widely appreciated. It is due to the failure of the temporary canine to absorb before the crown of the permanent canine starts on its downward course. A glance at a dissected skull of a child of six years will show why. The tip of the permanent canine is palatal to the apex of the temporary canine root and not labial as so many people imagine, so that failure to absorb in the early stages causes palatal displacement of the permanent tooth.

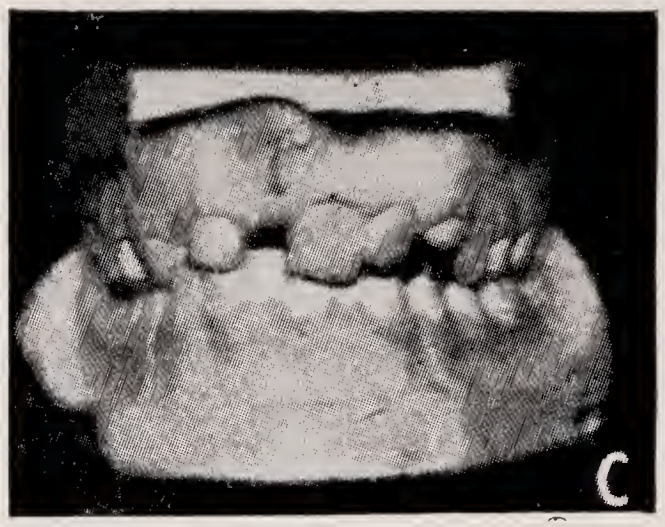
The technique adopted in these cases was to localise the tooth by X-rays and expose as much of the crown as possible under a local anæsthetic. The gum flap was then sewn back into position with the portion immediately over the crown cut away. This aperture was then packed with zinc oxide and oil of cloves or B.I.P.P. gauze for about a week or ten days. At the end of this time a small cavity was prepared in the palatal aspect of the tooth and a small ring cemented into position. This is done as follows: An elliptical cavity is prepared and undercut with a wheel bur. A piece of stainless steel wire is bent into the shape of a ring as shown in Fig. 5 so that the free ends will just enter the long axis of the cavity. The ring is then rotated through 90 degs. so that the ends become fixed in the undercut. Cement is then flowed round the ring to fill the cavity and fix the ring.

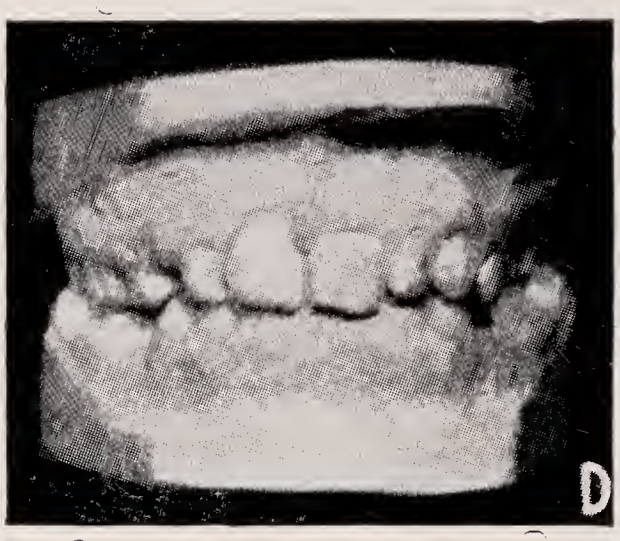
Fig. 3.

Fig. 4. (*M.B.*)

A. *March*, 1943.
B. *April*, 1946.
C. *April*, 1943.
D. *May* 1943, *with ring in position.*
E. *November* 1945.

(*This film should be reversed*).





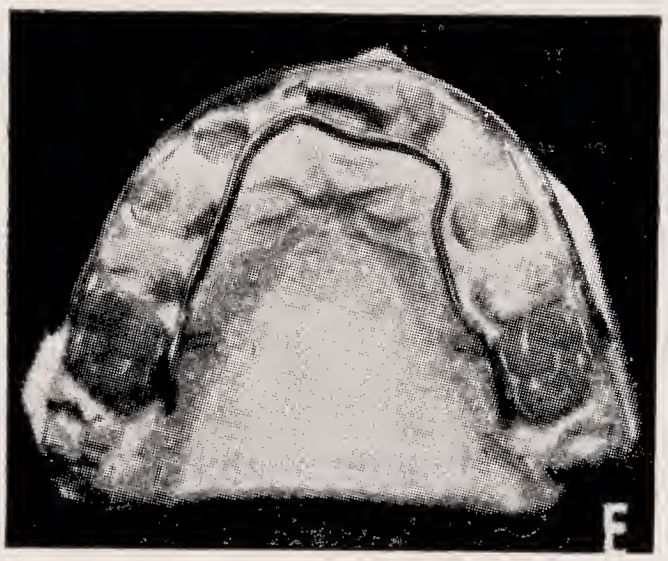


Fig. 5. (*J.N.*)
A. *March* 1944.
B. *May* 1946.
C. *April* 1944.
D. *April* 1946.
E. and F. April 1944 *showing apparatus used.*

Two cases treated by this method are M.B., a girl aged sixteen years, and J.N., a girl aged thirteen years, who is still receiving treatment.

Case 1. R.F. (Fig. 1.) Boy aged nine years. Both upper centrals were unerupted and lying high up in the labial sulcus together with two unerupted supernumeraries.

Treatment.

12.1.39 Models and radiographs taken.

8.2.39 Supernumeraries and some bone removed in $\underline{1\,|\,1}$ region under local anæsthetic. Two sutures inserted.

19.9.39 $\underline{1\,|\,1}$ region again opened up under local anæsthetic and packed B.I.P.P. as tissue had healed over on first occasion.

1.5.40 Upper appliance fitted. $\underline{4\,|\,4}$ were banded as $6\,|\,6$ had previously been extracted. $\underline{1\,|\,1}$ were also banded and spring pressure applied from buccal arch.

5.3.41 Fixed appliance removed and retention plate fitted. The retention plate was worn for six months all the time and for a further ten months at night only.

Case 2. P.B. (Fig. 2.) Boy aged ten years with unerupted $\underline{1\,|\,1}$ and two unerupted supernumeraries lying high up in the labial sulcus.

Treatment.

19.9.42 Examination—models and radiographs taken.

1.10.42 Supernumeraries and some bone removed in $\underline{1\,|\,1}$ region under local anæsthetic. Packed zinc oxide and oil of cloves, two sutures.

1.6.43 Fixed appliance fitted. Bands on $6\,|\,6$ buccal arch and spring to move $\underline{|\,1}$ distally.

16.9.43 $\underline{|\,4}$ extracted.

9.3.44 Fixed appliance removed and expansion plate fitted.

1.3.45 Retention plate fitted which was worn continuously for three months and at night only for six months.

Case 3. M.B. Girl aged sixteen years, had $4\,|\,4$ removed some years previously to make room for $\underline{3\,|\,3}$ to erupt before being referred by her dental surgeon owing to the failure of $\underline{|\,3}$ to erupt.

Treatment.

1.4.43 Models and radiographs taken which showed $\underline{|\,3}$ to be lying horizontally in the palate.

15.4.43 $\underline{|\,3}$ surgically exposed and bone over crown removed, packed B.I.P.P. gauze.

18.5.43 Ring cemented into $\underline{|\,3}$.

1.6.43 Fixed appliance fitted with bands on $6\,|\,6$ palatal arch and spring which was ligatured to ring in $\underline{|\,3}$.

18.1.45 Inclined plane fitted to $123\,|\,123$ to move $\underline{|\,3}$ over bite —upper arch was removed.

28.2.45 Inclined plane removed and arch refitted, $\underline{|\,3}$ being now over the bite.

18.9.45 Appliance removed. Case complete.

An interesting feature of this case is that although X-rays were taken at the time of removal of $\underline{4\,|\,4}$ the operator failed to appreciate the true position of $\underline{|\,3}$.

Case 4. J.N. Girl aged thirteen years with a history of $\underline{1\,|}$ being removed accidentally at a school clinic. This was found on radiograph to be lying high up in the labial sulcus, so that the tooth removed at the school clinic was probably a supernumerary.

Treatment.

7.3.44 Impressions and radiographs taken.

20.3.44 $\underline{1}|$ opened up under local anæsthetic. Packed with B.I.P.P. gauze.

1.6.44 Fixed appliance fitted with bands $\underline{6}|\underline{6}$ buccal arch and spring ligatured into ring on $\underline{1}|$.

9.1.45 Ring removed from $\underline{1}|$ and band fitted to allow better control of tooth movement.

1.10.46 $\underline{4}|$ extracted under local anæsthetic. Case still under treatment.

It will be seen from the cases illustrated that a good result can be assured even in the older cases. Three cases over 20 years of age, each with unerupted canines in the palate are now being treated successfully.

It has, however, been noticed with the typical cases of unerupted central incisors with supernumeraries, that the teeth show signs of hypoplasia in many instances and several times it has been found advisable to extract the teeth.

Another interesting feature of this type of case is that the unerupted teeth usually show signs of delayed development of root formation as well as delayed eruption.

I am indebted to Mr. Tavenner of the Dental School of the University of Birmingham who has been responsible for the surgery involved and his interest in all the problems encountered.

* * *

THE AUTHOR'S GNATHOSTAT

By W. RUSSELL LOGAN, L.D.S. (Edin.)

A SIMPLE GNATHOSTAT was demonstrated consisting of a face-bow with mouth-plate to which was hinged at the posterior end an upper bow. In use the patient held the mouth-plate covered with composition in the teeth. The face-bow was adjusted and the upper bow so that the latter lay on the Frankfort Plane as defined by Simon. Pointers on the upper bow were adjusted to the Orbital Points. All screws were secured and the apparatus removed from the patient. An upper cast was then fixed on the mouthplate the teeth filling the impression in the composition of the patient's occlusion, the whole apparatus was reversed to rest on the upper bow. A base of plaster was adapted to the cast its lower surface of necessity lying on the patient's Frankfort Plane. The cast was removed from the Gnathostat and articulated with the lower cast. A base was made parallel to the base of the upper by sinking the lower in soft plaster and levelling the upper by means of a spirit level.

* * *

THE TWIN WIRE ARCH.

By B. R. TOWNEND, L.D.S. (L'pool.)

THE TWIN WIRE ARCH, devised and used by Dr. Joseph E. Johnson, consists of a double strand of hard stainless steel wire of 0.25 or 0.3 mm. in diameter fitted into stainless steel end tubes which in turn fit into buccal tubes welded onto molar bands. As the Standard fittings for this technique are not available in this country, modifications were devised and shown in which various materials ready to hand were used.

A jig for cutting the end tubes to correct length ($1\frac{1}{8}$ inch) and a special vice for drawing the crimped wire into the end tubes were demonstrated together with a pair of pliers for crimping the wire.

The method of making the channels which are welded onto the strips of 3 mm. $\times$ 0.15 mm. stainless steel from which are formed the incisor bands was shown, together with a jig for welding the channels exactly parallel to the length of the band material so that the bands will lie accurately at right angles to the long axis of the tooth. Band forming pliers for making the incisor bands were shown. These pliers pull the band from the lingual aspect of the tooth, the pinch formed being tacked together with a weld, the ends cut off 2 mm. from the band, folded over flat against the band, and welded solid.

Other attachments were demonstrated including a method of soft soldering intermaxillary hooks onto the end tubes and a spring driving device for retracting the incisor teeth.

Fine helical springs for driving back molar teeth and spreading crowded incisors are an important adjunct of the twin wire arch technique, and a simple apparatus for forming these springs was shown.

The demonstration also included various models of the apparatus in operation including several in plastic material.

A full description of the Twin Arch technique by Mr. Townend appeared in the January, 1946 issue of the Dental Record.

* * *

AN INTERESTING CASE OF CLEFT PALATE AND HARE LIP

By MARIE CLAIRE STRANGE, L.D.S. (Eng.)

THIS CASE is interesting for two reasons : firstly, it shows a bilateral cleft of the lip combined with a complete cleft of the soft palate, while the hard palate appears to be unaffected. Secondly, the number and size of the upper incisor teeth are unusual. I have not seen a similar case described in any of the articles or textbooks on hare lip and cleft palate.

The boy is seven years old, and was referred to me for orthodontic treatment last February. His bilateral hare lip was operated on in Reading General Hospital at ten months of age with a very good result. There is a good buccal sulcus, the shape and the size of the lips are good, the upper lip being mobile and not tight. Apart from slight scarring on the upper lip, the facial appearance is normal.

The soft palate was operated on at two and a half years in Great Ormond Street Hospital. The operation was carried out in two stages. The first stage involved tonsillectomy and the second the closure of the cleft by means of two lateral incisions extending well back into the tonsillar fossa on either side, the flaps being sutured in two layers. The result was a long mobile palate. The child's speech is normal and he has needed no speech training.

The most interesting aspect of the case is the disposition of the upper incisor teeth. The occlusion of the posterior teeth is quite good, despite the loss of the lower right and upper left first deciduous molars. The upper deciduous canines are in linguoclination, but the deciduous upper centrals are in quite good positions for a case of this kind.

Fig. 1.

Fig. 2.

Fig. 3.

The deciduous upper laterals, however, are abnormal both in size and position. They are rotated distopalatally, as is often the case with hare lip, and are easily twice the size of normal deciduous upper laterals. It is possible they are deciduous lateral incisors geminated with supernumerary incisors.

The X-rays show the position of the permanent dentition. The upper centrals appear to be normal in size and clinically they can be felt to be erupting in the usual manner. The upper premolars and canines also appear to be normal. In the upper incisor area, however, there appear to be several teeth in excess of normal. There is a small supernumerary on either side, which I presume is the precanine. On the right side there is another malformed supernumerary and on each side of the centrals there seems to be a tooth

Fig. 4.

Fig. 5.

which I presume is the permanent lateral. These laterals (if they are laterals) like their predecessors in the deciduous dentition, appear to be abnormally large and rotated. This is an unusually large number of incisor teeth for a case of hare lip.

I have wondered why a hare lip alone should cause so much disturbance in the incisor region. A hare lip is usually accompanied by a disturbance of the upper incisor teeth, but there appears to be

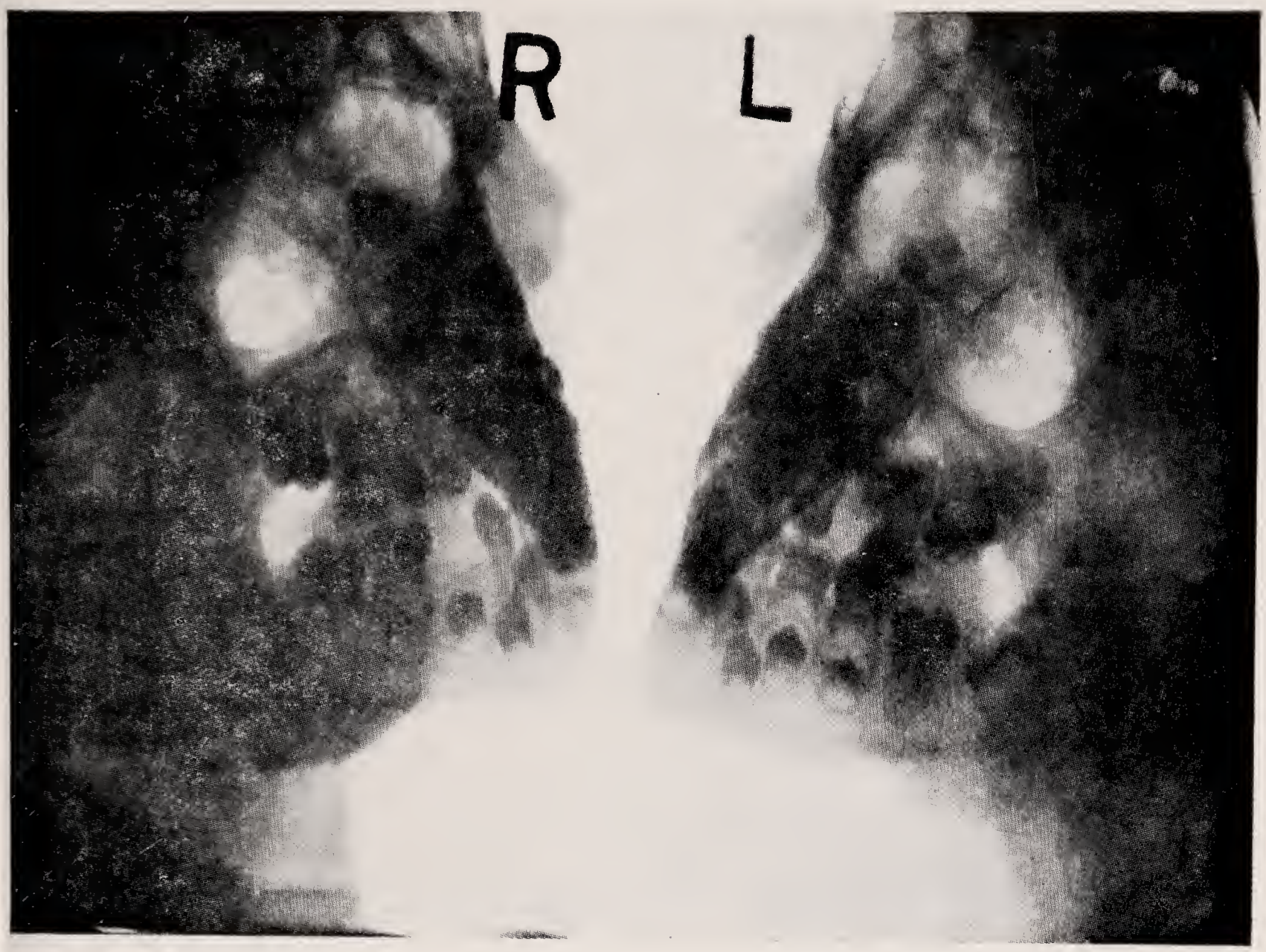


Fig. 6.

no satisfactory explanation as to the cause. In fact, I found very little about the behaviour of the teeth in cases of hare lip and cleft palate in any of the textbooks on the subject.

Broderick showed, in 1935, several cases of hare lip, and he demonstrated that in each of these cases a submucous cleft of the hard palate could be seen radiologically. I would hesitate to state that the occlusal X-ray I have shown demonstrates a submucous cleft though this would explain satisfactorily the reason for the irregularities of the teeth.

I would be much interested to hear the views of other members of the profession, particularly those who have had experience with this type of case.

* * *

DISCUSSION

The President said that Mrs. Strange had given an interesting description of a case of bilateral hare lip and cleft of the soft palate. The photograph of the child's face which she had shown indicated that the æsthetic result was extraordinarily good, and he had noticed from the models that a very satisfactory labial sulcus had been re-formed. He was not quite satisfied that in the enlarged pictures of the X-rays he saw both permanent laterals.

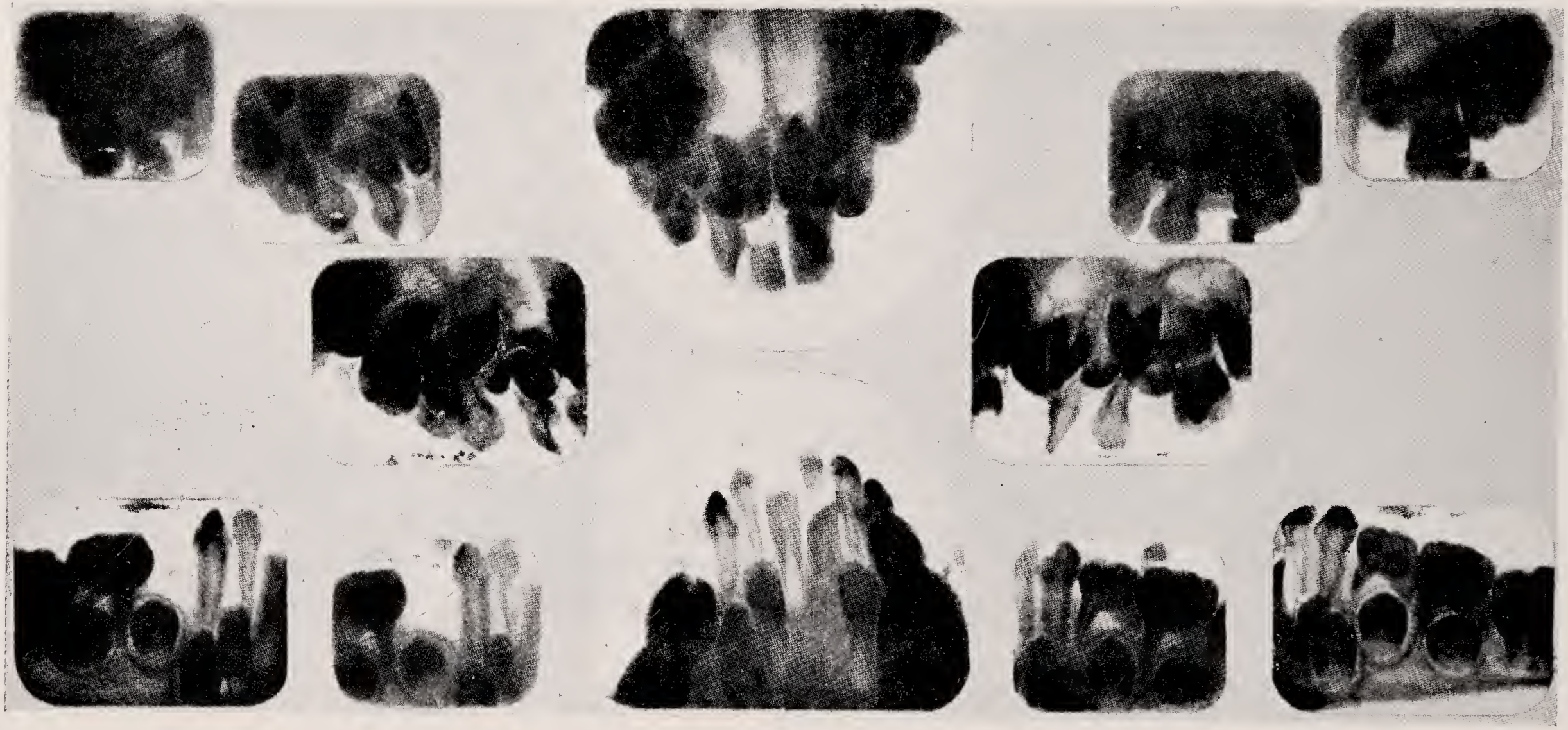


Fig. 7.

Mr. L. Ball said it had been suggested that the interference with the blood supply in cases of cleft palate had something to do with the aberration of the teeth and he would like to know whether Mrs. Strange could give any information on that point.

Miss K. C. Smyth showed a model of an upper jaw which she had found when turning out a large number of models that had become disarranged in the confusion arising during the war. It was labelled "Male, aged 1 year and 9 months," and it showed a very similar position of the lateral incisors or geminated teeth (it was difficult to tell which they were) to that shown in Mrs. Strange's case. The case appeared to be one of hare lip or cleft palate, but unfortunately there was nothing to show its history.

It seemed strange that there were so many extra teeth in the case shown by Mrs. Strange, as one was accustomed to the absence of a tooth or teeth in cases of hare lip. There was such a superabundance of teeth in the present case that it would be difficult to sort them out when they came through.

Cleft palate and hare lip cases were a tremendous orthodontic problem, and she felt that orthodontists did not study them as much as they should. They might with great advantage go to the dental departments of hospitals such as Great Ormond Street and study the cases of cleft palate and hare lip, as more of them came to clinics than to private practitioners. Orthodontists did not know as much about them as they should from the developmental and the operative points of view. From the dental point of view there was an enormous difference between a case that had been surgically treated in the most skilful manner, as Mrs. Strange's case had been, and a case which had suffered the appalling devastation of the dental arch and teeth which was sometimes seen as a result of the old-fashioned operation in which the tissues were all pulled together, without regard to any possible future occlusion of the teeth.

She wished to thank Mrs. Strange for bringing forward such an interesting case.

Mrs. U. Oliver asked whether there was any history of supernumerary teeth in other members of the family to which the case shown by Mrs. Strange belonged.

Mr. N. Gray said he had noticed in the clinic at Eastbourne lately a number of children with unerupted permanent teeth— not cleft palates—and the extraordinary frequency with which incisors were completely unerupted owing to the presence of supplementary teeth. He had seen a child of 12 years of age with central incisors unerupted, and in every such case there had been a supplementary tooth in the palate. He did not know anything about cleft palates, but it had struck him that these aberrancies were associated with unerupted supplementary teeth also.

Mr. H. Chapman, referring to Mr. Gray's remarks, said his own experience was that when there were deciduous centrals present and permanent laterals erupted, all in the upper jaw, there was a supernumerary tooth to correspond to each of the deciduous centrals that were present. He regarded that as pathognomic, and he had not yet found an exception to it.

Mrs. Strange, in replying to the discussion, said there was a distinct similarity between the case which she had described and the

one of which Miss Smyth had shown a model, the lateral incisors being about the same size and in the same position in the two cases. It would be interesting to know whether there was any similarity in the permanent dentition.

With regard to the President's remarks, she would like to have his opinion on her X-rays and hoped he would look at them afterwards. There was such a jumble of teeth that it was difficult to tell which was which, and she was not at all sure about them.

With reference to Mr. Ball's question, she had read as much as possible about the theory of the malformations in question and she knew there was a theory that the blood supply interfered with the arrangement of teeth in cases of hare lip, but that had not been proved.

In reply to Mrs. Oliver, she had questioned the mother of the child about her relations and the other members of the family, and the mother was very vague on the subject, but, as far as she could gather, their teeth were more or less normal.

She agreed with Mr. Gray's remarks. She had found that unerupted teeth were associated with supernumerary teeth, and it would be very interesting to see which teeth came through and which did not come through in the case that she had described. She had extracted the deciduous incisors, which were decayed and very loose. She had seen the patient last week, and the permanent incisors were then coming through very well.

She would be very grateful if members would look at her X-rays and let her know what they thought about them, because she was very interested in such cases and would like to know whether there were any new theories on the subject.

She would also like to know whether any of the members had any ideas about sub-mucous clefts. Mr. Broderick had said that in his opinion they were usually responsible for the aberrations associated with hare lip, but in the American textbooks on the subject it was stated that sub-mucous clefts were very rare. Hare lips, however, were not very rare.

* * *

THE TEETH OF THE KABYLES

By HUBERT C. VISICK, L.D.S. (Eng.)

WHEN I WAS ASKED to read a paper before this Society in 1938, I thought it might interest you if I made a study of the teeth of the Kabyles—a pure white race living in the mountains of Algeria, far removed and isolated from the outside world for many centuries.

I was fortunate in having a friend, Mr. H. G. Lamb, living in the heart of these mountains, who had carried on mission work for over forty-five years in a remote native village 3,000 feet up in the mountains. To give an idea of the isolation of this village—called Tabarouth—I may mention that fifty years ago it was several days' journey on mule-back from the nearest road ; and even a dozen years ago it took us four hours.

Among his other activities, my friend had a large dispensary, and hundreds of patients presented themselves for treatment in a single day. There were also classes for children of different ages, all of whom I was able to examine.

These Kabyles are naturally suspicious, and resent the slightest interference, so my investigation was possible only through the unique influence and confidence my friend had won by a lifetime of service among them.

HISTORY

The North Coast of Africa has been inhabited for 3,000 years by Berbers, a white race without a trace of Hamitic blood in them. This part of Africa, being exceedingly fertile, has suffered invasion and conquest at various times by almost all the nations bordering the Mediterranean. First the Phœnicians, 1000 B.C. Then the Romans from 300 B.C. held the country for 600 years or more, and it became the granary of Rome. There are still abundant signs of their occupation. Then in 537, the Arabians swept along the whole stretch of North Africa in their religious war of conquest in the name of Mahomet. Later came Vandals, Greeks, Turks, Spaniards, and finally the French in 1830.

In 1830 the French, with the acquiescence in other nations using the Mediterranean, decided to put an end to the depredations of the Moors—a mixture of all the invading nations. It proved a difficult task and it was thirty years before it was accomplished.

During all these thirty centuries groups of Berbers had successfully resisted conquest or assimilation. Today there are five main groups, the best known being the Riffs of Morocco, the Touregs of the desert, and the Kabyles of Kabylia. These last inhabit the coastal mountains in Algeria, a district stretching from the sea to the desert, and measuring roughly 100 by 150 miles.

KABYLES

These hardy mountaineers, on the approach of enemies, retreated into the inaccessible fastness of Kabylia and, living up on the tops of the rocky mountains, defied conquest, and have to this very day remained a distinct and separate race.

Fig. 1. *Kabylia.*

This history accounts for the fact that their villages are perched on the tops of the mountains and in most unapproachable places, with all doors facing inwards. No one enters a village without permission, and after stating his business.

Like the other inhabitants of North Africa, they are Mohammedans, but that is their only contact with them. They still retain their own laws and customs and language. They are fanatical, proud and uncontrollable. Treachery abounds, and some villages are given over entirely to assassins.

The village is the unit of social life. Each village is self-contained and has few dealings with its neighbours. They do not marry outside the race, and keep within the family clan if possible, to preserve the family name. Marriage of first cousins is common and considered desirable.

The race is increasing, but individuals are short-lived. Men average 45-55 and women may reach 65-70. Their wants are supplied by what they can win from the soil. Ten years ago it was unusual to see any but native and local utensils—clay pots and pans, mud food jars, mats of rushes, wool garments woven by the housewife in her own hut, crude axes of native-wrought iron, and wooden ploughs.

Fig. 2.
Young married " shut in " Marabout.

Fig. 3.
Marabout aged 9. Gums very hypertrophied. Only slight caries.

Fig. 4.
Marabout. aged 20, Class II. Post-normal molar occlusion, projecting upper incisors. All four wisdoms missing. Gums healthy. Teeth not decayed. All spaced.

Fig. 5.
Kabyle, aged 14, Class I. Normal molar relationship, but lower incisors crowded. Tartar everywhere. Gums very unhealthy. No caries.

They cultivate tiny patches of earth around the village, or descend thousands of feet into the valleys to find more earth. There are no wide, flat valleys as we know them. The mountains rise to a height of 9,000 feet and run steeply down to the rushing torrents at their bases. The Kabyles keep cattle, sheep, goats and mules, which live in the same hut with their owner, and are driven out on the hillside to get what food they can, under the constant watchful eyes of the boys.

Fig. 6. Kabyle girl, aged 9. Of rich family. Teeth well spaced, gums healthy. Only three deciduous molars.

Fig. 7. Kabyle youth, aged 18, Class I. Upper right canine in palate. Lower right canines instanding. No caries, gums healthy.

The dwellings are of rough stones piled up with no cementing material, and roofed with crude tiles. The only opening is the door. Smoke from the fire escapes through chinks in the walls and roof.

Huge mud food jars surround the central space, separating the inmates from the animals. The floor is made from fresh cow dung and mud, smeared over the floor and up to and around the base of any object standing upon it, leaving smooth, round corners everywhere, like a modern operating theatre, and with the same object—no place for insects to hide.

There is no furniture, but rush mats for sleeping on and perhaps a cradle of a sheet of cork, hanging from a beam ; and, most important of all, the hand-mill cemented to the floor.

Life is hard and the people are living on the verge of starvation. Children are undernourished ; 75 per cent. die in their first year ; those that survive develop into a hardy race.

Kabyles are fairer than either Italians or Spaniards, and their cast of features is much the same as ours. Women, when not tanned by the sun, are as white as English people, and they always go bare-footed.

The climate is very trying—sirocco in summer and heavy snow in winter. Many are killed by the weight of the snow causing the roofs to collapse.

Babies are not weaned until two or three years of age. Even after the next child is born they share the milk. Grandmothers allow the babies to suck to comfort them, but of course there is no milk. When they begin to eat they eat anything : figs—their only sweet—and beans, peas or lentils—pods and all. Diet is practically vegetarian. Everyone gets meat once a year at the Feast, or on special occasions—weddings, births of boys, or when an animal dies. There are two meals a day—at ten o'clock in the morning and at night after work. The morning meal consists of bread dipped in olive oil if they can get it, and "leavings" and water. The evening meal—"Cous-cous"—a steamed flour preparation like semolina, moistened with watery lentil soup. In season they steam onions,

Fig. 8. *Village olive press.* (*Wooden screw cut with native axe.*)

Fig. 9. *Mother and daughter carrying water-pots.*

marrows and stalks of wild herbs. For the well-to-do familes dried figs are a great treat and are eaten alone or with bread. Sour milk is a luxury for those who can get it ; eggs, also a luxury, for boys. Bread for the poor is made from ground-up acorns. For the others, a mixture of beans, oats and peas is ground into flour just before use. If available, a little wheat is added. It is sifted, and the bread is made for the males. What is left—the roughage—is for the females. The bread is unleavened. It is thick ($\frac{3}{4}$ inch) like a pancake, turned over and over on a flat earthenware pan. It is tough and becomes hard if kept. The only food needing mastication is bread, and dried figs. "Cous-cous" is swallowed unmasticated.

MARABOUTS

Before I describe the dental conditions, I want you to take particular note of the following facts.

Among the Kabyles, and to the uninitiated quite indistinguishable from them, is a race of people called "Marabouts." They speak the same language, eat the same food, have the same customs

Fig. 10. *Kabyle interior. Mill, food jars, cradle. N.B.—Hole beneath jar, where chickens lay their eggs.*

and laws, and live in exactly the same way, with a few minor exceptions, which, however, may have some bearing on our investigation.

They usually live in separate villages, but sometimes mix up with other Kabyles in the same village. Intermarriage is rare, but if it takes place it is usually a Marabout man with an ordinary Kabyle woman. Physically there is nothing to distinguish them, but they are usually more intelligent and cultured. In a way they correspond to the tribe of Levi among the Jews.

Like all Kabyles, they are Mohammedans, but it is from the Marabouts alone that the Sheiks (or priests) are drawn. The whole Marabout race is considered "holy" and worthy of respect.

The Marabouts are thought to be a later addition to the race of Kabyles—possibly the descendants of the fanatics who in the seventh century conquered North Africa in the name of Mahommed. From our point of view, the interesting thing is the astonishing difference between their teeth and those of the other Kabyles. Their teeth are in every way strikingly superior.

My investigations were principally confined to two villages about a mile apart. The one called Tabarouth was predominantly Kabyle, and the other, called Taaroust, was a Marabout village where I examined about 75 children. Altogether I made records of some 250 mouths ; 160 of them were of children under fourteen.

TABAROUTH

I will describe the conditions I found among the ordinary Kabyles first.

1. Nearly all mouths were dirty, and the gums swollen and inflamed. In a number of cases—particularly in the deciduous

Fig. 11. *Kabyle wife spinning wool.*

dentition—the gums were hanging in flaps which exposed the roots of the teeth right down to the apices. I am not describing "patients," but the ordinary run of children. They made no complaint of anything wrong.

2. Hardly a single case was seen in which there was no caries or gum trouble.

3. The teeth of males were superior to those of females.

4. Teeth of the poor much inferior to those better off.

5. Deciduous teeth very much inferior to permanent teeth.

6. Posterior teeth of both dentitions were worse than the anterior teeth.

7. Permanent incisors and canines of the young were seldom carious.

I extracted scores of teeth and found the bone was soft and almost cork-like. The first permanent molars are large ; the second molars considerably smaller ; and the third diminutive or absent.

No impacted third molars were seen. Only one supernumerary tooth was seen, and that was a peg-shaped one between the two lower central incisors.

One boy of fifteen had malformed second premolars in the mandible. They were large and flattened. Nearly all deciduous incisors and canines are stained a dark brown or black on the cervical half. The most usual place for caries seemed to be on the buccal surface.

Fig. 12. *Kabyle man.*

Classification was not always easy in the conditions under which the examination was carried out ; and mutilation, due to caries and extraction, complicated matters. But normal antroposterior occlusion of the molars was typical.

Out of the 160 children examined, there were 7 definitely post-normal, and 1 possibly pre-normal. The majority of children had crowding of the incisors and canines. The commonest irregularity seems to be a crowding out of the canines. Narrow, high-vaulted palates and protruding of upper incisors, which we associate with mouth-breathing and thumb-sucking, were absent. But I saw several cases of projecting and widely separated upper incisors and canines with wide, flat arches. It is a type I have always associated with people of a Jewish or Hindu origin.

A signicant fact is that Kabyle children *never* suck their thumbs. When born they are swaddled, and their arms are bound tight to their bodies. When unswaddled they yell for the first thing they see—dried figs or unripe fruit—and suck away at that. Is thumb-sucking a pernicious habit acquired by Western babies in the first few months of life ?

I cannot remember one massive jaw of the Esquimo or negroid type.

After considerable coaxing and bribery, I was able to get impressions of about thirty cases whose mouths appeared to be of special interest.

I regret that some of the best models have been lost during several war-time moves, but I have a few illustrations.

TAAROUST

In this exclusively Marabout village, only a mile from Tabarouth, I examined about 75 children, and was astonished to find strikingly different dental conditions. All mouths were clean and healthy, arches well formed, and deciduous teeth well spaced. There was little or no caries or gum trouble. There was little difference between boys and girls. I had formed the opinion at Tabarouth that the condition of the mouths depended on the food, both as to quantity and quality ; but here at Taaroust there is just the same poverty, and they eat exactly the same food as the ordinary Kabyles. There is, however, this perhaps significant fact : Marabout women and girls do not eat food inferior to that of the men and boys, and unless very poor do no hard work in the fields like the Kabyles. When a girl reaches marriageable age, she is "shut in" for the rest of her life, and does not leave her house.

It appears quite obvious that at Tabarouth the insufficient food of the poor (and the females) has a bad effect on the teeth and gums. But it seems that to be born a Marabout guarantees immunity against dental defects, whatever the conditions of life.

It would be unwise to be dogmatic in formulating any theory to account for the differences in the teeth of the Kabyles and the Marabouts, on the evidence so far obtained. But I am going to suggest that on present facts, hereditary is an obvious explanation. As dentists, and especially as orthodontists, we are compelled to recognize the astounding force of heredity. Here, I believe, we have an example of that force still operating after a period of over a thousand years, and giving these Marabouts the benefit of their ancestry away back in Arabia. Admittedly, this investigation is only local and confined to one district, but it opens up some interesting possiblities for further study.

Summary of dental conditions of Marabout children under fourteen :—

Number examined : 64—25 boys and 39 girls.
Normal or Class I occlusion : 62.
Class II, div. 1 : 2, both boys.
Children with perfectly sound teeth : 40—boys, 17 ; girls, 23.
Number of carious teeth : 58, in 24 mouths—15 carious teeth in 8 boys ; 43 carious teeth in 16 girls.

NOTES

Before I close I should like to mention a few facts given me by my friend—the result of his wide experience. They may help to fill in the picture which I have sketched in outline.

You will realize the value of his information when I tell you that on one of his many tours through the mountains he has extracted over 500 teeth in nine days. He estimates that for every man with one tooth needing extraction, he saw five women with their teeth in ruins. Upper canines are frequently crowded out. Impacted third molars are very rare. Rickets is very common, especially among girls. Jaw bones are soft, and greenstick fractures common. Goitre occurs only in women and girls.

Girls are not now supposed to marry until they reach the age of fifteen, but they often do. Until recently nine or ten was the usual age. All girls are sold. Babies are born about every two years, and there are many miscarriages.

Most children are under-nourished, but stuff themselves to repletion at harvest-time, and to the point of danger at the Annual Feast. Fashionable women rub their gums and teeth with the root bark of walnut trees, not for cleanliness, but to impart a reddish-brown colour to the gums and lips, which by contrast make the teeth look white. This bark is imported and is expensive. Men and boys occasionally rub their gums (anterior only) with any handy green stuff, just to clean them. Nearly all old people are edentulous, and cannot masticate the bread. If possible, they leaven it and eat it fresh-baked. If it is hard, they first pound it with a stone, and then swallow it whole.

Patients kiss your hand when you extract a tooth, and take the tooth with them to burn in the fire, or pound it to pieces while they curse thoroughly. They sometimes put a piece of rock salt in the socket.

* * *

DISCUSSION

The President congratulated Mr. Visick on his very original and instructive paper, which, he said, revealed him in an entirely new role. He had not been aware that Mr. Visick had added exploration to his many other activities.

He would like to know whether Mr. Visick had any information about the condition of the nose and throat in the case of the Kabyle children. Did those children suffer from naso-pharyngeal troubles ? He asked that question because Mrs. Lindsay had noticed that the child in one of the photographs shown on the screen had her mouth open, but perhaps Mr. Visick had asked the child to open her mouth so that the irregular teeth could be seen. The child's neck appeared to be swollen, as though she had a certain amount of adenitis.

Mr. Visick said he had omitted to enquire into the condition of the nose and throat, but the dentition gave no indication of mouth-breathing. He had asked the child in question to open her mouth in order to show the incisors.

Mr. H. Chapman said that Mr. Visick had presented the Society with a very unusual paper. The new role in which Mr. Visick had revealed himself did not surprise him as much as it had surprised the President, because he had known Mr. Visick for a longer time. He knew that very early in his career Mr. Visick had gone to California and acted there as a very competent guide to places not quite as wild as the land of the Kabyles but places to which he had never been before. The story he had told in his paper on the present occasion was as appropriate to Blackwood's Magazine as it was to the Transactions of the Society.

Mr. Visick had described two races living side by side, eating similar food and having similar customs, with only slight variations, and the percentage and types of irregularities appeared to be similar to those in this country, so it was interesting to consider the factors which were popularly supposed to have a bearing on ætiology. Breast-feeding was an outstanding example. The Kabyle children were not weaned until they were two or three years of age, so according to some of the literature irregularities should be non-existent. The factor of breast-feeding operated at the earliest age and so might be expected to have the utmost influence. With regard to the diet of the Kabyles at a later stage, the bread alone

needed mastication, so the suggestion might be made that function after weaning was a negligible factor in the production of good occlusion. But what about the people of this country ? Was their diet of such a nature that it required a greater effort on the part of the jaws to prepare it for the following stages of digestion ? Even if the diet of the Kabyles required even less effort in that connection, was not that more than offset by the long period of breast-feeding ?

With regard to caries and pyorrhoea, there seemed to be a good case for the view that better diet resulted in a healthier mouth as distinct from irregular teeth, because the poor and the females of the Kabyles, who lived on an inferior diet, had more unhealthy mouths.

He believed that people were born with good or bad quality teeth, which might be influenced by post-natal conditions, but, with regard to irregularities, he thought that if people were born with good jaws nothing could alter them subsequently. Local factors were in a different category and had no bearing on the size of the jaws and their relationship.

He would have liked Mr. Visick to be more precise about some details. At what age were the lower incisors crowded ? At the age of 6, 7 or 8 years that might be a normal condition, whereas at the age of 12 or 14 years it would be abnormal. Similarly, were the crowded canines due to a small maxillary base or to local causes ? He inferred the latter, because Mr. Visick had said that there were no narrow jaws.

It was very interesting to be reminded that swaddling prevented sucking habits, and it might be a hint to orthodontists in regard to the treatment they gave. He sometimes advised that a child's arms should be tied, but he was not sure that that was ever done. If the child would allow it, it was a very simple and easy way of stopping thumb-sucking.

He understood that the Marabouts, the race higher in the social scale, had healthier mouths than the Kabyles, but he did not know whether they were better from the orthodontic point of view.

Mr. Visick said they were very much better ; the jaws were almost perfect.

Mr. Chapman asked whether the Marabouts had larger jaws than the Kabyles.

Mr. Visick said that was the case. The jaws of the Marabouts were much better in shape than the Kabyles, being more rounded, and all the deciduous teeth were spaced ready for the permanent teeth.

Mr. Chapman said that Mr. Visick had stated that the Marabouts had well formed arches, in contradistinction to the words he had used about the Kabyles, who he said had no narrow jaws. Was that a difference in words only or had the two terms different meanings ? Also, which deciduous teeth were spaced, and at what age? Were the mouths of children in the older age group dirty ? It would be interesting to know who had extracted the teeth which made classification difficult and whether they were deciduous or permanent teeth.

An investigation such as that which Mr. Visick had reported was of the greatest interest and value. It seemed to show that orthodontic conditions were similar wherever human beings existed.

In support of that there were Miss Smyth's investigations at Bradford-on-Avon as well as the members' own knowledge of the conditions in London today. It seemed doubtful whether anything could be done to obviate cases due to ante-natal causes. The deductions to be drawn from the orthodontic point of view were that, over long periods of time and in localities remote from one another and without any connection with one another, orthodontic problems existed in similar phases and in similar percentages. The conclusion could therefore be drawn that, in the words of the first of Sir Frank Colyer's three main headings of causes of irregularities, malocclusions were the result of the tendency in nature to variation ; that they were ante-natal in origin, as was confirmed by Miss Clinch's models of new-born children, and that the possibility of prevention was remote ; in fact, there was no suggestion as to how they might be prevented.

He did not think that an orthodontist must know the ætiology in order to treat a case successfully, for it was everyday experience that many typical deformities were improved enormously (in using the word " deformities " he had in mind the malocclusions included in Angle's and Bennett's classifications), so long as they were not of a gross type.

He thought that Mr. Visick's paper was of absorbing interest from the dental point of view and from the pictorial point of view it left nothing to be desired. He congratulated Mr. Visick on having made so many trips and having given to the Society such a valuable contribution.

Mr. Russell Marsh congratulated Mr. Visick on his paper, which he was sure everyone present had enjoyed very much, and said he would like to join issue with Mr. Chapman on certain points.

He did not agree with Mr. Chapman that the orthodontic conditions amongst the Kabyles were similar to those that were found in this country. It seemed to him, from what Mr. Visick had said, that the typical orthodontic conditions amongst the Kabyles were not similar to the orthodontic conditions which were typical in this country.

With regard to the question of breast-feeding for a period of three years, on a previous occasion Mr. Chapman had cited, as a proof that breast-feeding did not ensure a good dentition, the fact that poor women in the east end of London tended to feed their children for two or three years, partly for the sake of economy and also because of the superstition that a woman could not become pregnant whilst she was feeding a child. He maintained that such an excessive period of breast-feeding as three years actually constituted a condition of starvation for about two years and during that period of under-nourishment—a very important developmental period in the child's mouth—the seeds were sown for an orthodontic condition which showed itself later on. He did not think that breast-feeding for three years would bring about a better dentition ; he thought it would naturally cause a worse dentition.

He was not persuaded, as Mr. Chapman appeared to be, that the causes of orthodontic conditions were necessarily ante-natal. He thought that starvation and poor diet might have a very considerable effect in producing them. He did not know whether he was right in supposing that the superior race, the Marabouts, were on the whole more well-to-do and better fed than the Kabyles.

The softness of the bones which Mr. Visick found when he extracted teeth seemed to be a very significant factor when taken in conjunction with the orthodontic cases that occurred. Otherwise he gathered, from what Mr. Visick had said, that there was not a larger percentage of orthodontic conditions than there was in this country.

Mr. J. Aitchison said he would like to thank Mr. Visick for a most interesting paper.

Mr. Visick had seemed to him to build up a very fine argument for a functional improvement in orthodontics when he spoke of the poorer race, the Kabyles, who had a long period of breast-feeding, followed by a life in which there was very little-worth while mastication, producing irregularities and crowded arches, but then Mr. Visick completely cut the ground away from that by saying that the wealthier race, the Marabouts, did very little more mastication but had well formed arches. He therefore had to dismiss from his mind the idea that the outstanding point which Mr. Visick emphasised was the lack of function in the jaws of the people.

He had been very interested in the dental anatomy of the molars described by Mr. Visick, and he had noticed, in the excellent models which Mr. Visick showed, the very enlarged first molar and the very marked difference in the size of the second and third molars. That was a very interesting point, and he did not think it had been brought out in the case of any of the other people amongst whom there had been inbreeding.

With regard to the caries to which Mr. Visick had referred, in view of the highly farinaceous diet of the people he would like to ask where the caries occurred. Was it the occlusal caries which was found amongst animals in captivity or was it the interstital caries that was associated with a more primitive diet ?

Mrs. L. Lindsay said she wished to express her admiration of the work that Mr. Visick had done and his courage in going to such an uncivilised country. She also wished to congratulate him on the beauty of the photographs that he had shown ; she believed that Mrs. Visick had coloured them, and that had certainly been done most skilfully.

She was reminded of the fable of the centipede and the frog. The centipede was quite happy until the frog in fun asked her which leg went before which, and

> " The centipede, considering which,
> " Worked her feelings up to such pitch
> " That she fell down into the ditch,
> " Forgetting how to run."

Mr. J. H. Glen asked whether Mr. Visick had noticed that the extremely large first permanent molar occurred in both the Kabyle and the Marabout children. It might be that the type that had the better ante-natal feeding produced larger second and third molars. There was a close relationship between the development of the second and the deciduous dentition.

Mr. O. B. Brears said that Mr. Visick had dealt in his paper with larger issues than orthodontics and he was sure everyone present was very grateful to Mr. Visick for his paper. He hoped that papers of a similar type would be read before the Society on future occasions. There was a large number of races living in isolated

conditions, and he thought Mr. Visick's work might stimulate other members of the Society to find out something about such races ; they might possibly do it during their summer holidays if it could not be done by people living in the countries in question.

He would like to ask Mr. Visick who the Kabyles were anthropologically and what language they spoke or to what group of languages their language belonged. From the photographs which Mr. Visick had shown, he thought the Kabyles were very similar to some of the races in the Himalayas and they presented very similar orthodontic problems.

Mr. Chapman had suggested that Blackwood's Magazine would be interested in Mr. Visick's story, and personally he was sure that would be the case, but he hoped that the paper and the photographs accompanying it would be submitted to the Royal Geographical Society. That Society was now widening its outlook and trying to connect up with other branches of science, and he was sure it would greatly value Mr. Visick's paper and photographs.

Miss R. Caseley said she had very much enjoyed Mr. Visick's interesting paper and would like to ask him how the dental age of the Kabyle children compared with that of children in this country. Did the eruption of the teeth take place earlier or was it delayed ? In many orthodontic cases in this country it was found that the eruption age was early and the age of development of the bone was late. She wondered whether that question was affected by the sucking action on the masticating muscles and the teeth when the children were breast-fed until they were 3 years of age.

Mr. H. C. Visick, in replying to the discussion, said that when making his investigations amongst the Kabyles he had often wished that he had another orthodontist with him to help him and suggest details for which he ought to look. Time after time he had come across a child with a mouth in excellent condition, and on each occasion he had been told that the child was the daughter of a Sheik. All the Sheiks were Marabouts. The condition of the gums of the Kabyle children was very bad indeed, but they did not bleed. He attributed the condition to the fact that the children lived on a starvation diet.

He did not agree with Mr. Chapman that the orthodontic conditions amongst the Kabyles were similar to those in this country. Only 7 of the 160 children under 14 years of age that he examined had been definitely postnormal. The molar relationship was normal in about 97 per cent. of the cases. He did not think that was so in this country.

The children's teeth were usually extracted by the village blacksmith, but they very often went to Mr. Lamb, at the mission station, to have the work finished off. Everything was very primitive amongst the Kabyles, but he found them very intelligent and charming people, although they were fierce and there were often fights between the different villages. Mr. Lamb had told him that 22 people had been killed in a village just across the valley and that he had gone there to attend to the wounded and probe for the bullets. On one house he had seen marks of the bullets fired by brigands who had entered the village and fired away for an hour or two. In some of the villages all the men were assassins, and if anyone wanted someone killed he would send to those villages for a man to do it.

In reply to Mr. Chapman's question as to when the lower incisors of the Kabyle children were crowded, he would say that they were crowded all the time. That did not apply to the Marabout children, who had very well spaced lower incisors in the deciduous dentition.

He had not seen any of the high palates that were found in this country and were associated with mouth-breathing, but, as would be seen from the models, some of them were rather narrow. In those cases in which the canines were pinched out all the teeth looked very big and the canines could not get in.

With regard to Mr. Russell Marsh's question about the food of the Marabouts, only certain members of the Marabout race were Sheiks, but those that were Sheiks were well fed, because they were the chief spiritual leaders in the villages. The other people in the villages made a fuss of them ; they cut their wood and drew their water for them, and the Sheiks fed very well and had excellent teeth. The same applied to the men who acted as mayors of the villages and who were wealthy men. Every time he saw a child with a good set of teeth he found that the child came from a wealthy family, and he therefore came to the conclusion that the poor food was the cause of the bad condition of the teeth of most of the Kabyle children.

He had suggested in his paper that heredity over a period of a thousand years might have something to do with the difference between the teeth of the Marabouts and those of the Kabyles, because some of the Marabouts were just as poor as the Kabyles; they dressed in rags and lived in hovels with mud floors. They slept on the floor and sometimes a whole family slept on one old mat. The children were swaddled so tightly that they looked like a chrysalis ; they were put on the ground near the fire, and it sometimes happened that they rolled over into the fire and were burned to death.

No doubt lack of function was one of the causes of the shrunken arches that he found. The people had very little to masticate, the " cous-cous " which they ate being like semolina mixed with lentil water.

The difference in size of the molars was very striking, but he did not know the reason for it.

With regard to the origin of the Kabyles, it was supposed that they came from Syria, possibly before the Phœnicians, who came to North Africa about 1,000 B.C. and conquered the country, which they ruled until about 300 B.C., when the Romans came. The Romans lived in North Africa for six hundred years, and then the Arabians came. Later on people came from many other countries, but none of them ever conquered the Kabyles or penetrated into Kabylia, because Kabylia was a kind of natural fortress.

As to the age of eruption of the teeth, he thought that in a good many cases it was earlier than in this country. One child of 7 years of age had the first upper premolars coming through, but the first deciduous molars had rotted right away, so he supposed something had to come through.

On the motion of the President, a vote of thanks was accorded to Mrs. Strange and Mr. Visick for their interesting contributions, and the meeting then terminated.

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EXPERIMENTAL WELDER DESIGN

By G. J. PARFITT, L.R.C.P.Lond., M.R.C.S., L.D.S.Eng.,
and Professor SHELDON FRIEL, B.A., M.Dent.Sc.

THE WORK for this paper was undertaken to ascertain if a weld could be made in as thin a gauge of stainless steel as that used in Orthodontics, of a strength approaching that of the material, without destruction of any of its properties.

Although metals suitable for use in the mouth, and for the making of orthodontic appliances can be joined by soldering, or one of the welding processes, and stainless steel is only one of the suitable metals so used, it is felt that there is a considerable future for 18/8 stainless steel in orthodontics, particularly if the destruction of the metal surrounding the weld produced by the resistance welding process in general use, could be decreased or avoided altogether. Not only can this be done, but the hardness produced by the cold working of 18/8 can largely be preserved. How this can be attained and the variables involved, we are going to discuss, with suggestions for the design of a machine for use in the making of orthodontic appliances.

Resistance spot welding is the technical term used for the process, and it conveys the idea that the electrical resistance of the parts is utilised in the process, but it must not be forgotten that pressure is one of the main factors involved.

The welding temperature is obtained by passing an electric current through the parts to be welded, the power absorbed appearing as heat. The heat is proportional to the square of the current multiplied by the resistance multiplied by the time of current flow.

Each of the factors influencing the weld will be discussed separately; the current, the resistances involved, the time, the pressure and the electrodes.

TIME

The permissible time of the whole welding process is limited by the properties of the metal itself. If 18/8 stainless steel is held between the temperatures of 450° C. and 850° C. for any length of time, the stainless properties are increasingly diminished. Carbides are precipitated at the grain boundaries in the metal, and intergranular corrosion and weld decay follows. If the metal is cooled rapidly through this damaging heat range, carbides are kept in solution, and the stainless properties, for which this metal is largely used, are not destroyed. The time for such destruction is short, for the fully annealed state 1/10th second should not be exceeded, and for the cold worked state, which state favours carbide precipitation, 1/100 sec. should not be exceeded. To some extent the time depends upon the thickness of the metal welded. The weld must be made in so short a time as to prevent the heat reaching the outer surfaces of the components being welded ; the thinner the material the shorter the time. In the thinness of material used in orthodontics, even in the partly cold worked material, 1/50th sec. should not be exceeded. If a spot weld is made in a cold worked piece, over a period of, say, 1/25th sec., the metal in the centre of

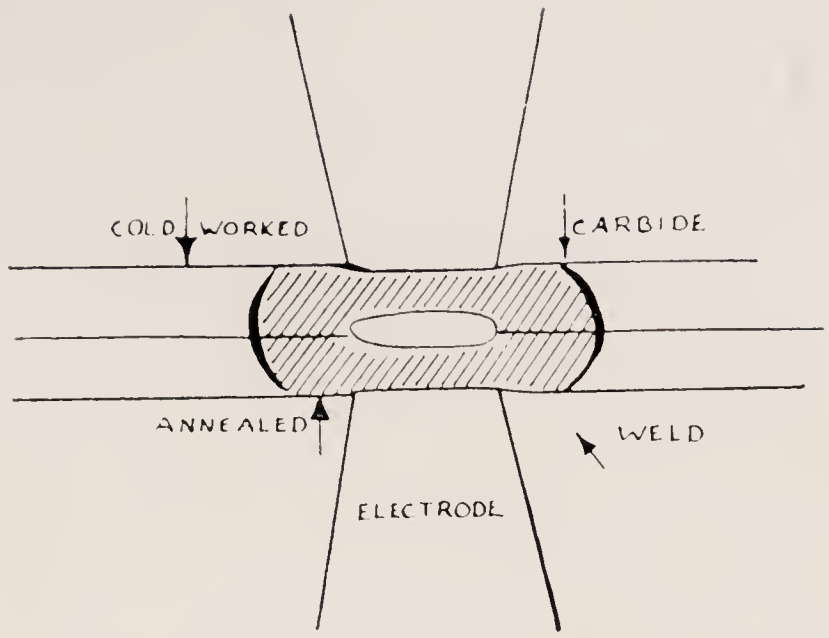

Fig. 1

Diagram showing cross section of a Weld made too slowly in 18/8. Wrongly shaped Electrodetips, Indentation of the work, annealed area, and Carbide precipitation.

Fig. 2.

Photograph of three 1 mm. wires after bending test. Lower ½ inch was gripped in vice and the free ends bent over by the same pressure, applied to their free ends. Upper wire has a side to side weld with one spot to a second 1 mm. wire made by low pressure at 1/20 sec. The middle Weld was made by high pressure and at 1/75 sec. some discolouration has occurred. Lower wire not welded. The middle wire has lost little of its cold drawn hard state.

Lower wires—One spot weld tested by bending, after welding two straight wires side to side,

the weld may well have been quenched through the critical heat range without mishap, but a ring of surface metal surrounding the weld will be elevated and maintained in this range, and will lose some of its stainless properties. (Fig. 1). If the metal can be melted, welded and cooled so that no part is held in the damaging heat range for more than 1/100th sec. then all the properties of the weld area will be retained. Moreover, if the process is of this speed, the weld does not assume the annealed state, the hardness of the cold worked state being largely retained (Fig. 2.) It is desirable, therefore, that for cold and worked material, the whole of the process be under 1/100th sec., both a rapid rise and a rapid fall of temperature being necessary.

If fully annealed material is used and not cold worked before welding, the welding time may be increased, but there is little advantage in doing so in such thin material.

A rapid rise of temperature can be brought about by a high current concentration, necessitating a suitable machine, and a rapid fall of temperature by quenching. At this high speed the cooling time is longer than the heating time. The time available therefore, for the passage of current is something less than 1/100th sec. or some annealing and destruction of the hardened cold work metal will be noticed.

RESISTANCE

The factor of resistance is one of importance for the power absorbed and turned into heat is in the proportion of I^2R.

Every resistance in the electrical welding current circuit absorbs its proportion of power and becomes heated. Were it only a matter

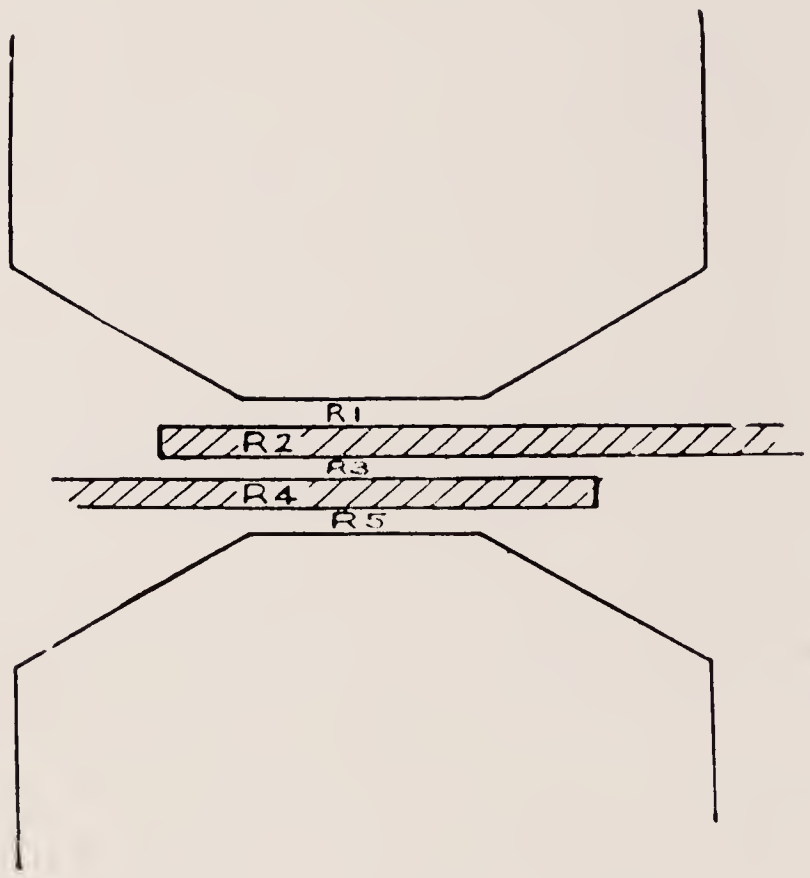

Fig. 3

Diagram of Resistances between the Electrodes.

R1. Electrode to Metal Surface contact resistance.
R2. Ohmic Resistance of part to be welded.
R3. Metal to Metal contact Surface Resistance.
R4. Ohmic Resistance of second part to be welded.
R5. Electrode to Metal Contact Surface Resistance.

of wasted power, this could be compensated for by a more powerful machine, but it is the appearance of heat in places other than that strictly required for the weld which claims attention. The resistances involved are those of the secondary coil of the welding transformer, the leads to the electrodes, the mechanical joints between connections, the electrodes and the resistances between electrodes which are the resistance of the parts to be welded and the three contact surface resistances comprising the upper and lower electrode to metal contact resistances and the metal to metal interface contact resistance. (Fig. 3.)

The coil, leads and electrodes should have ample carrying capacity and be short, so that as much power as possible is made available between the electrodes, and in this respect the area of the loop formed by the whole secondary circuit must be as small as possible. Of the resistances between the electrodes only some are desirable.

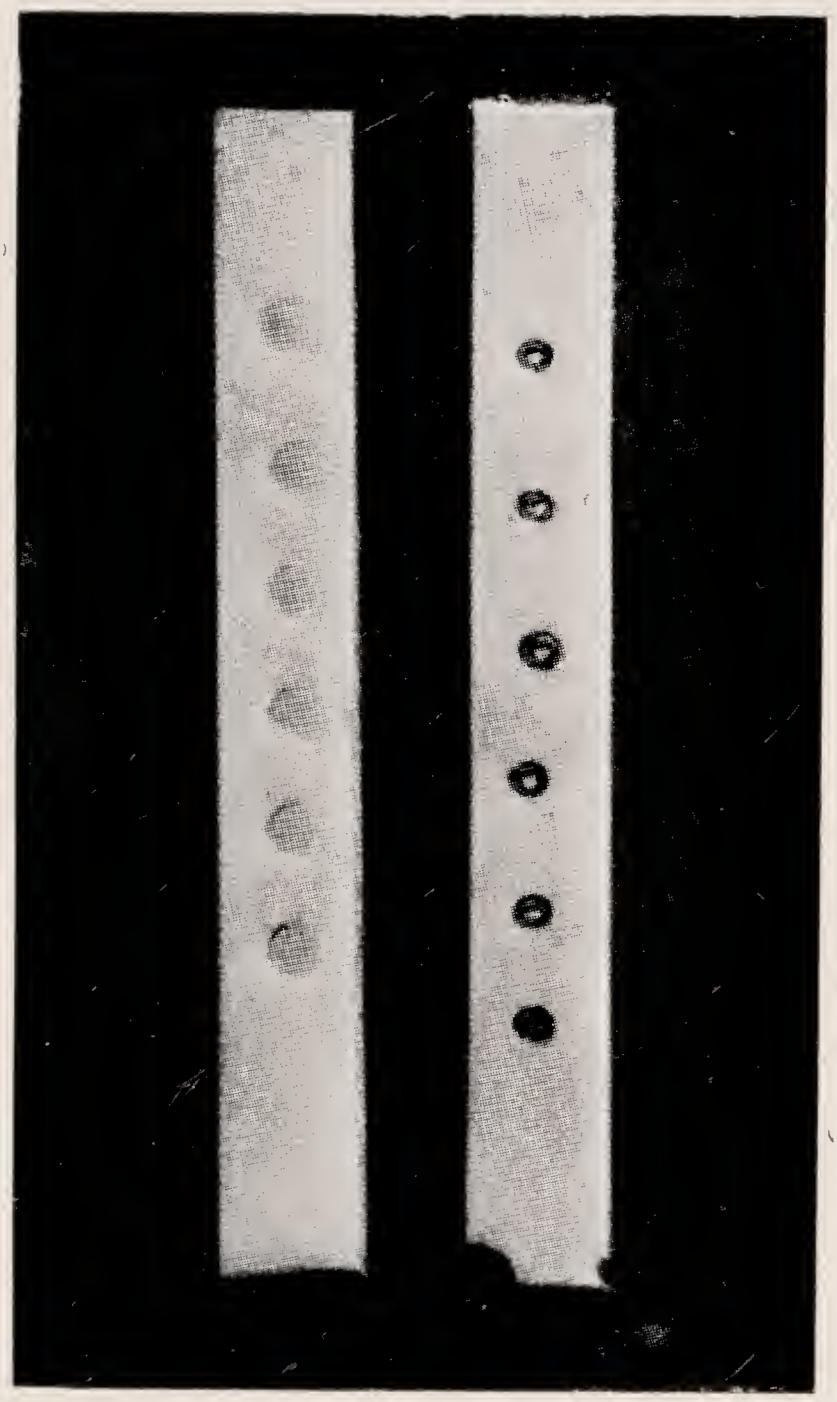

Fig. 4.

Photograph of two 5 *mm.* × 0.15 *mm. strips welded by six spot welds.*
Those on the left by high pressure and 1/100 *sec. showing some indentation, on the right by an AC machine with switch of* 1/20 *sec. and low pressure.*
Showing pitting and discolouration about the weld—burning.

The weld desired in 18/8 is a fusion of the metal surfaces of the parts to be joined over a definite area, it is generally stated, to a penetration depth of 40%—70% of the thickness of each part, but we have found in the narrow thin material under consideration that 30%—40% penetration actually gives a higher tensile strength for a single weld. In this fusion area, and this area alone, the welding temperature has to be obtained, and only in this area is absorption of power, electrical resistance and concentration of current desirable.

In this area the resistances are those of the metal parts themselves, and the interface metal to metal contact resistance. The resistance of the metal itself in 18/8 is considerable. The specific resistance of 18/8 is 50 times that of copper, making this metal one of the most suitable for welding by this particular process. Heat generated in the substance of the metal itself and the contact resistance will produce fusion at the interface surface and not at the electrode to metal surfaces owing to the cooling effect of the electrodes. Heat produced at the electrode to metal surface is undesirable. The resistance for unit area at the electrode to metal contact surface should therefore be as small as possible, for the path by which the heat is conducted away from the weld area lies across this contact, and if at this point there is a concentration of heat which must first be conducted away, there will be a delay in the final cooling of the weld. If due to low pressure the contact resistance is so high that fusion occurs at this surface, there will be severe pitting of the work and fouling of the electrode making further clean welding impossible. (Fig. 4.) The magnitude of the contact surface resistance per unit area, depends upon the finish of the surface, the presence of oxide or other films, the pressure and the electrode material. Under welding conditions the polished surface shows a marked reduction in surface contact resistance over that of the rolled or rough surface. More current is required to form a weld in polished material, and the weld so formed is stronger than a weld in the rough stock. If the rough surface be placed against the electrode, then slight discoloration of the surface occurs.

COOLING OF THE WELD AREA

Not only is 18/8 a poor conductor of electricty, but also of heat, the thermal conductivity being 20 times less than that of copper. In consequence the heat is localised to the weld area and not conducted away in the metal, but is lost from the surface, being materially aided by the close contact of a mass of cold metal of good thermal conductivity. Such a mass is the copper of the electrode itself and this constitutes the quench.

The shaping of the tips of the electrodes is of great importance. Not only does the tip convey the necessary current concentration to the spot, but also conveys the heat from the area, and at the same time submits the necessary forging pressure. They must be kept in the finest possible condition, neglect of this point is the most potent source of variation in precision welding. Any alteration in the shape of the electrode has great effect both in the welding of thin strip and of wire. The alloy from which the electrodes are made is also important ; it must be of suitably low thermal and electrical resistance, and yet be hard enough to withstand alteration of shape under high pressure, and also resist softening at temperatures up to 500° C.

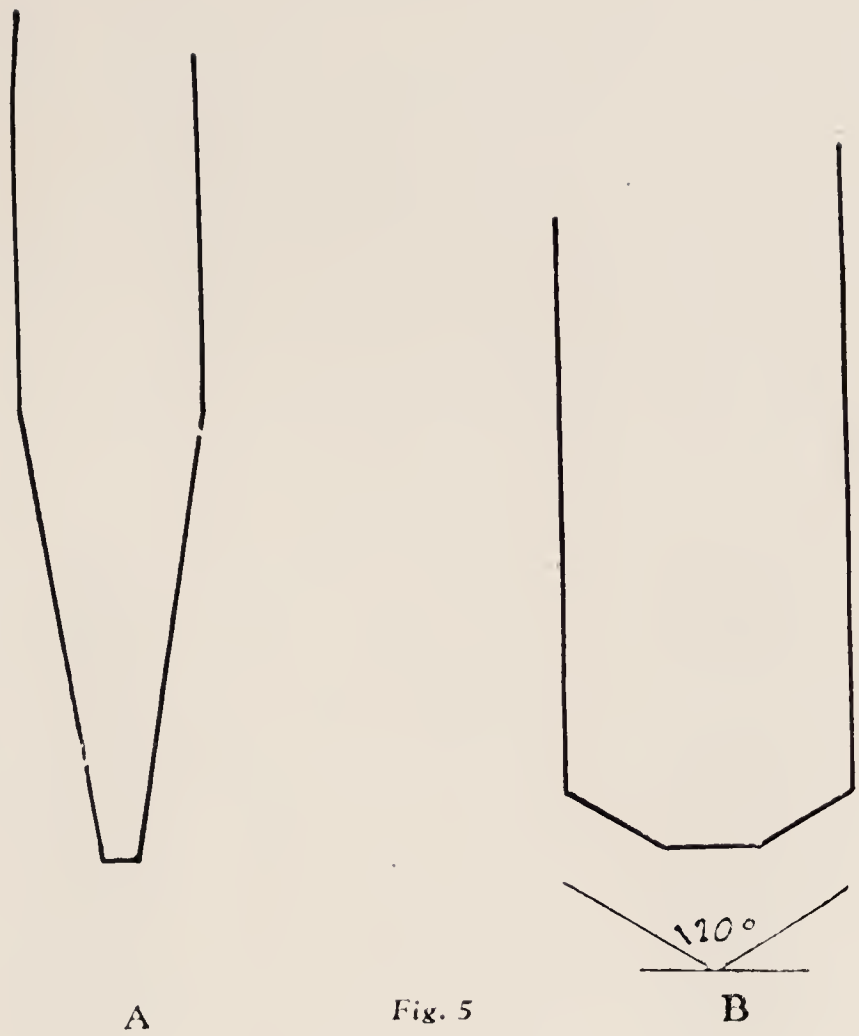

Fig. 5

Electrode tip shape.
A—Incorrect rake angle. B—Correct angle 120°

Johnson, Mathey & Co., Ltd., make a suitable range of electrode alloys for all purposes, the two most suitable for our work and the most satisfactory of any that I have used, is the Mallory 3 and Mallory 100, but others softer and harder are available for special requirements.

The recommended shape for the electrode is an included angle of 120° or rake angle of 30°, as a compromise between accurate localisation of the weld and effective cooling. Fig. 5. Where access to the work does not allow of this shaping, the electrode must be suitably altered, but if so much metal is removed that the included angle so formed is less than 90°, the cooling will be delayed and electrode life reduced 25%.

CURRENT

In the production of heat factors of time and current are inter-dependent, but do not vary in direct relation. The magnitude of the current in the welding circuit is of prime importance for the power absorbed in the resistances, and the heat developed depends upon the square of the current. The amount of heat required for a weld is critical, the current more so particularly in the rapid welding of stainless steel of such thin gauge. Over a small range, however, the current can be varied and the effect upon the weld noted. The material used for all these tests was 18 8 of thickness 0.2 mm., 0.15 mm. and 0.05 mm.

If the current on the machine is set at the lower end of the range it will be found that a slight alteration of the setting causes a jump from no weld at all to a fair weld ; this is due to the metal over the whole weld area being simultaneously elevated to the welding temperature. If welds are made at or close to this setting, erratic results will be produced. If the current is increased, the welds

become stronger owing to the greater penetration, until a point is reached at which expulsion of metal occurs. We find that at the higher settings near to the expulsion point the metal surrounding the weld is damaged so that with destruction tests the weld is torn out of the metal ; if, however, slightly less current is used than that to cause expulsion, this damage to the surrounding metal does not occur, and the specimen withstands loading to beyond the yield point of the annealed metal, (Fig. 6), finally tearing across as loading approaches the value given for the tensile strength of the hard drawn state.

Fig. 6.

Obverse and reverse of 18/8 *strip,* 3 *mm.* × 0.2 *mm. welded with one spot, which has undergone a tension strain of* 230 *lbs. and is just about to sheer across the weld. Electrode diam.* 2 *mm. Pressure* 230 *lbs.* 1/75 *sec.*

PRESSURE

Pressure has a dominating influence in this welding process. Pressure by the electrode tips must bring the parts together to be welded, and sufficiently deform them to localise the contact to the required area. Such localisation is more accurate in thin sheet. Pressure and current density values are therefore more accurately obtained in the thin sheet. Pressure must be adequate to forge the parts together during the whole time that the metal is in the plastic state. In the heavier sheet thicknesses the strength of the weld has been shown to increase with electrode pressure up to the limit that the electrode material will withstand, current values being suitably increased. Pressure alters the contact resistance values, and therefore alters the electrical conditions in the weld area. With pressures as low as 15 lb. per square mm. the contact resistance was found to be considerable, a weld of poor strength being obtained at low current density. Expulsion of metal also occurs at this low current value, and also fusion of metal at the metal to electrode surface. The weld area also in each case was far smaller than the electrode face. Finally, the pressure must be

maintained after the current has ceased to flow, to allow heat loss into the substance of the electrodes while the weld consolidates.

Pressures used were between 40 lb. and 80 lb. per square mm. the higher pressures giving stronger and more uniform welds, allowing greater current densities before expulsion of metal. The only disadvantage of high pressures, if indeed it be a disadvantage, is the indentation produced by the electrode. The indentation produced at 80 lb. per square mm. does not impair the strength of the weld but affects appearance. (Fig. 6.) We have found 60 lb. per square mm. a useful working pressure in the making of appliances.

ELECTRODE TIP AREA

The area of the electrode tip still remains to be considered, for upon this will depend the area of the weld and the actual magnitudes of the current and pressure required of the machine. If, for any thickness of plate the electrode tip area is made too small, the current is over concentrated at this point. This produces surface fusion, deep indentation, expulsion of metal, pitting and damage to the electrode. Mr. N. A. Tucker has pointed out that there is an economical tip diameter for each thickness of plate to be welded, small tip diameters soon mushrooming to give an effective area equivalent to the economical value. This economical value is when the tip diameter approximates the square root of the plate thickness in inches. The recommended tip area for thicknesses of sheet 0.2 mm. to 0.05 mm. is 3 square mms.; for the thinner sheet 2 square mms. may be used if desired.

Having obtained a weld of good quality, it is necessary to maintain this quality in subsequent welds. The factors of current, time, pressure, and resistance must be kept constant. The most difficult to keep to standard is the electrode tip, alteration of which affects the current density, the pressure per unit area and the contact resistances.

The strength of a single weld is dependent upon its area, but there is no advantage in increasing the size of the weld in such thin material beyond three square millimetres.

EXPERIMENTAL WELDER DESIGN

The machine for use in welding thin 18/8 strip and hard drawn wires up to 1 mm. diameter must be capable of giving an adequate current density over an area of 3 square mms. and pressures up to 250 lb., together with some accurate timing device of current duration of 1/100 or even less, depending upon the requirements. The pressure device must also be capable of a smart follow up on the collapse of the parts during the weld, or at that moment the pressure will be released with loss of metal and interruption of the forging pressure. This requires small light moving parts free from excess friction. These are the main essentials in the design. There is no difficulty in obtaining a machine to give these conditions of time, current and pressure, but certain other requirements are necessary in a machine for use in the making of orthodontic appliances, notably the design of jaws and electrodes. For such fine work rigidity of the electrodes to lateral thrust, accessibility, and the quick changing of electrodes are essentials.

Turret heads are required, and we favour the nearly horizontal lower electrode pointing forward and the upper vertical electrode

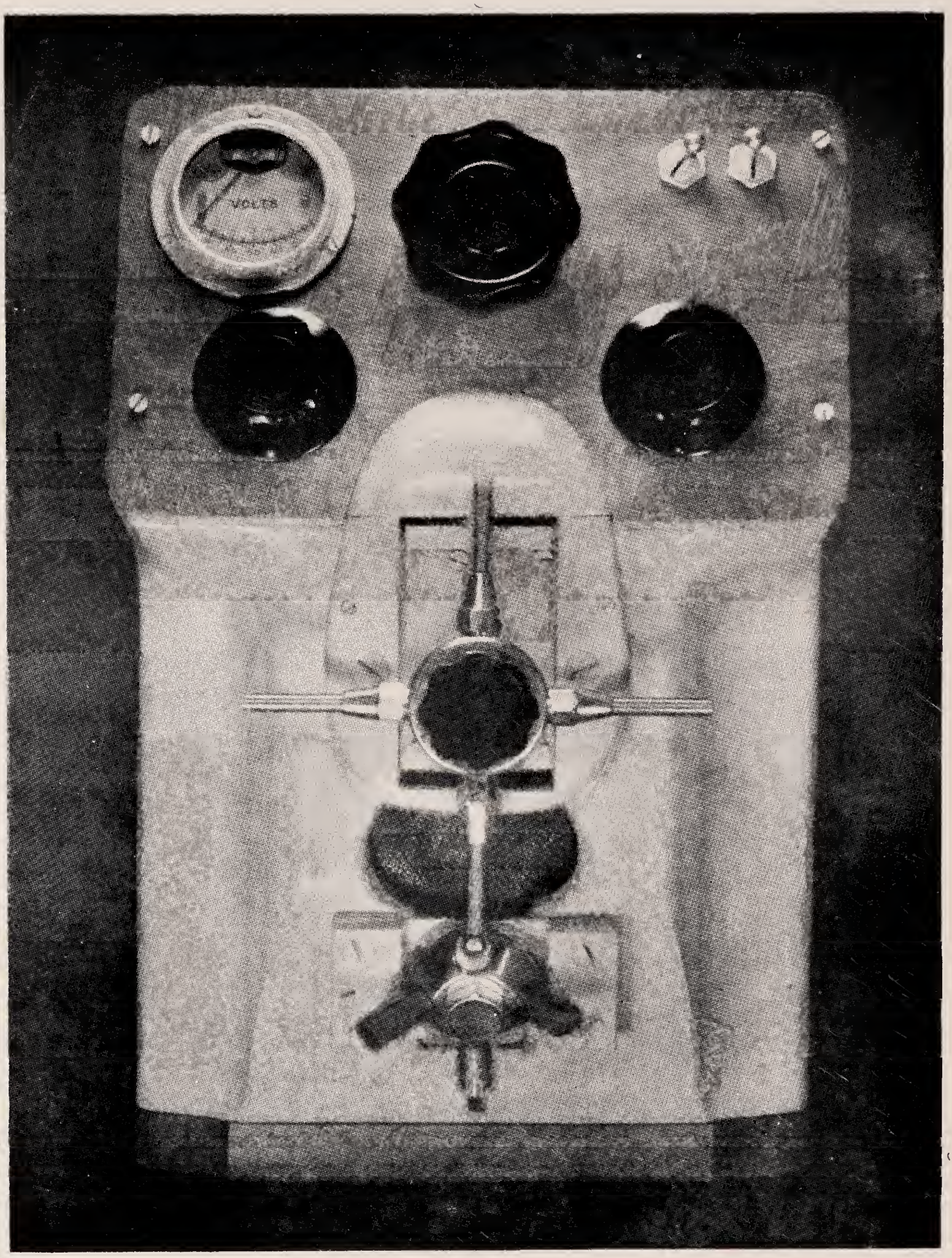

Fig. 7.

Front view of Welding machine showing upper and lower turret heads, position of electrodes and panel. Control panel—Central knob, voltage selector with 12 positions giving voltage variations of 230 volts to 800 volts. Volt meter reading voltage applied to condenser plates. Lower left knob, pressure control, 50 lbs to 300 lbs. Lower right knob, voltage adjuster control in primary of welding transformer. Main switches, (top right) for filament and high tension, high tension set obliquely.

to give maximum visibility and accessibility for work and hands: they should be in a good light and near to eye level.

We maintain that there is a place in orthodontics for the highest quality weld obtainable, not only can the lightest gauge of materials be used with certainty, but the minimum number of welds can be used in the making of an appliance with the advantage of maximal strength with the minimal damage to the metal and minimal wear on the electrodes.

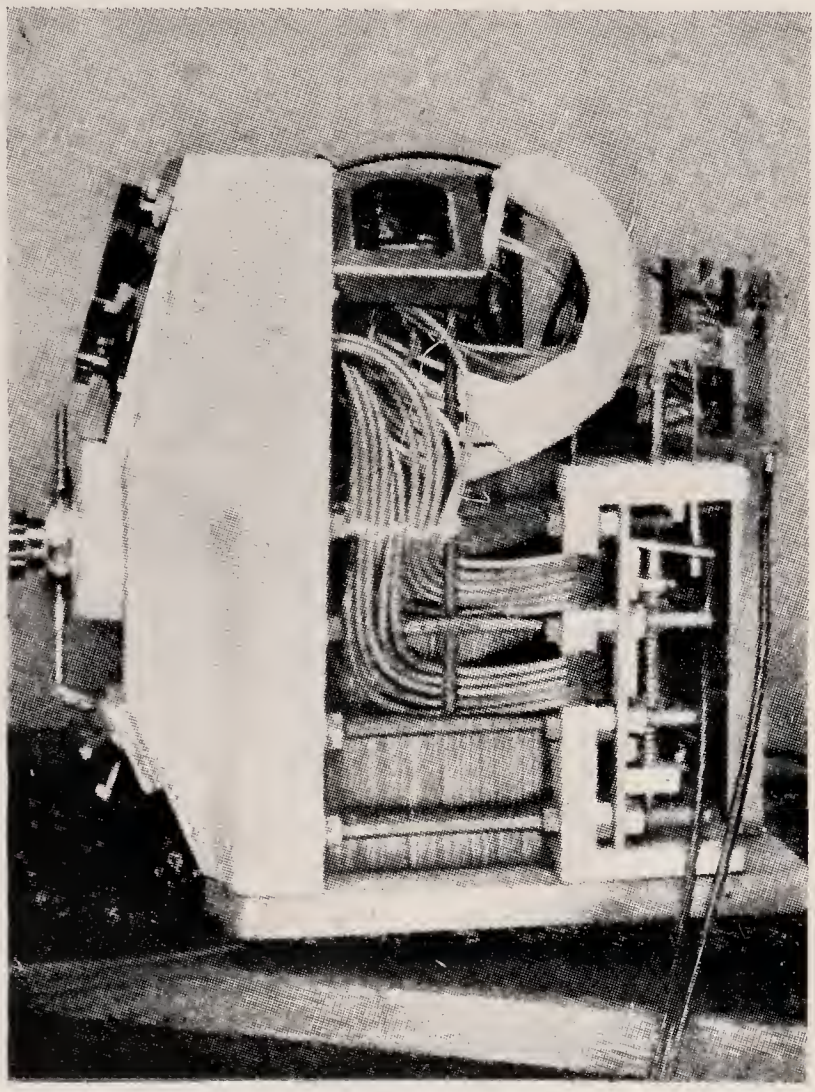

Fig. 8. Side view of welding machine with cover removed to show interior. Note turret heads and position of upper and lower electrodes.

The design of the experimental machine we have made up is as follows :—

(Fig. 7 and Fig. 8.)

The upper and lower electrodes are short and are carried on two small turrets of brass or bronze. The upper turret is carried on a light sliding carriage running on three widely separated parallel slides, one close to and behind, but out of the way of the upper electrode in use, the two others above and widely separated one from the other, giving a three point rigidity with easy vertical sliding motion to the upper electrode with little friction and inertia. The lower turret carriage is bolted, but insulated from the anterior transformer casting.

These carriages are immediately in front of the 5—10 KVA welding transformer, the one turn secondary coil of which is flexible and soldered directly behind the carriages immediately behind the turret heads. The loop formed by the secondary circuit is small, the inductance therefore minimal. The resistance of the

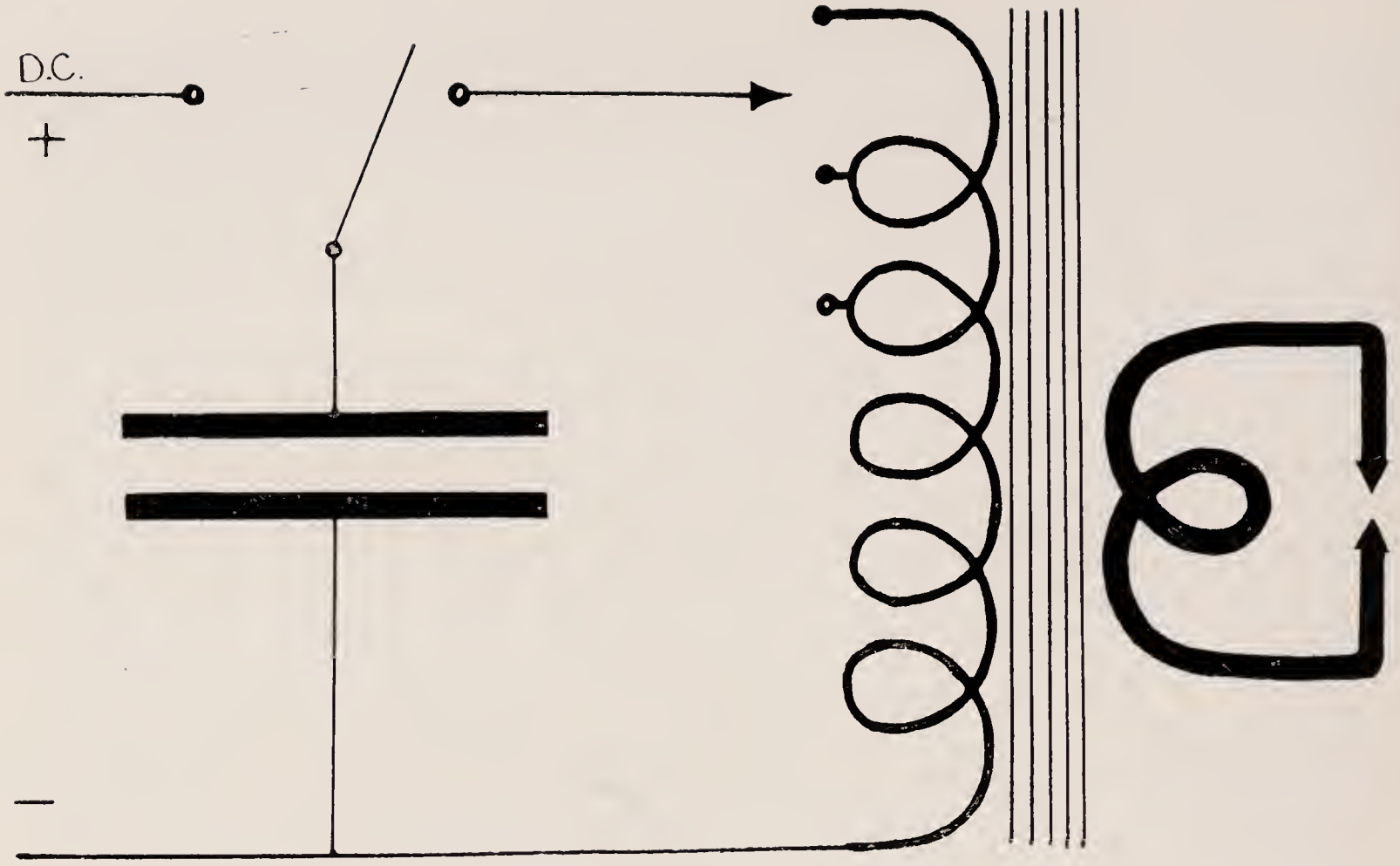

Fig. 9

Simplified welding circuit. Storage capacity condenser, switch, and welding transformer

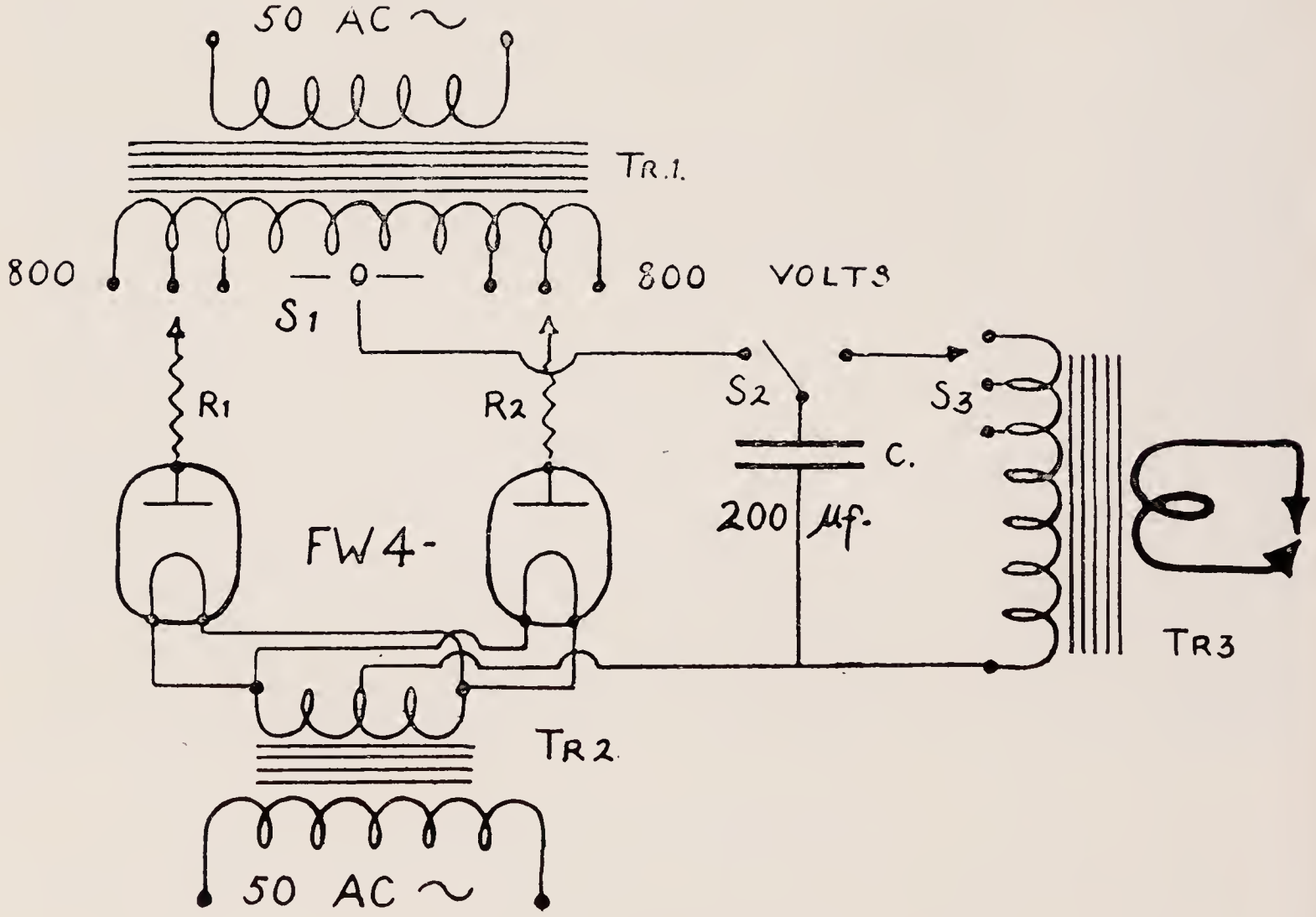

Fig. 10

Welding circuit. FW4. rectifying valves. Tr.1. A.C. mains transformer, output tapped 800-0-0 *volts ; Tr.2. A.C. mains transformer, output* 4 *volt centre tapped, for filament heating. Tr.3. Welding transformer output to carry* 3000 *amps. S.1. Voltage selector switch, A.2. Automatic charge and firing switch ; S.3. Voltage adjusting switch. C. Capacity storage condenser,* 200 pf.

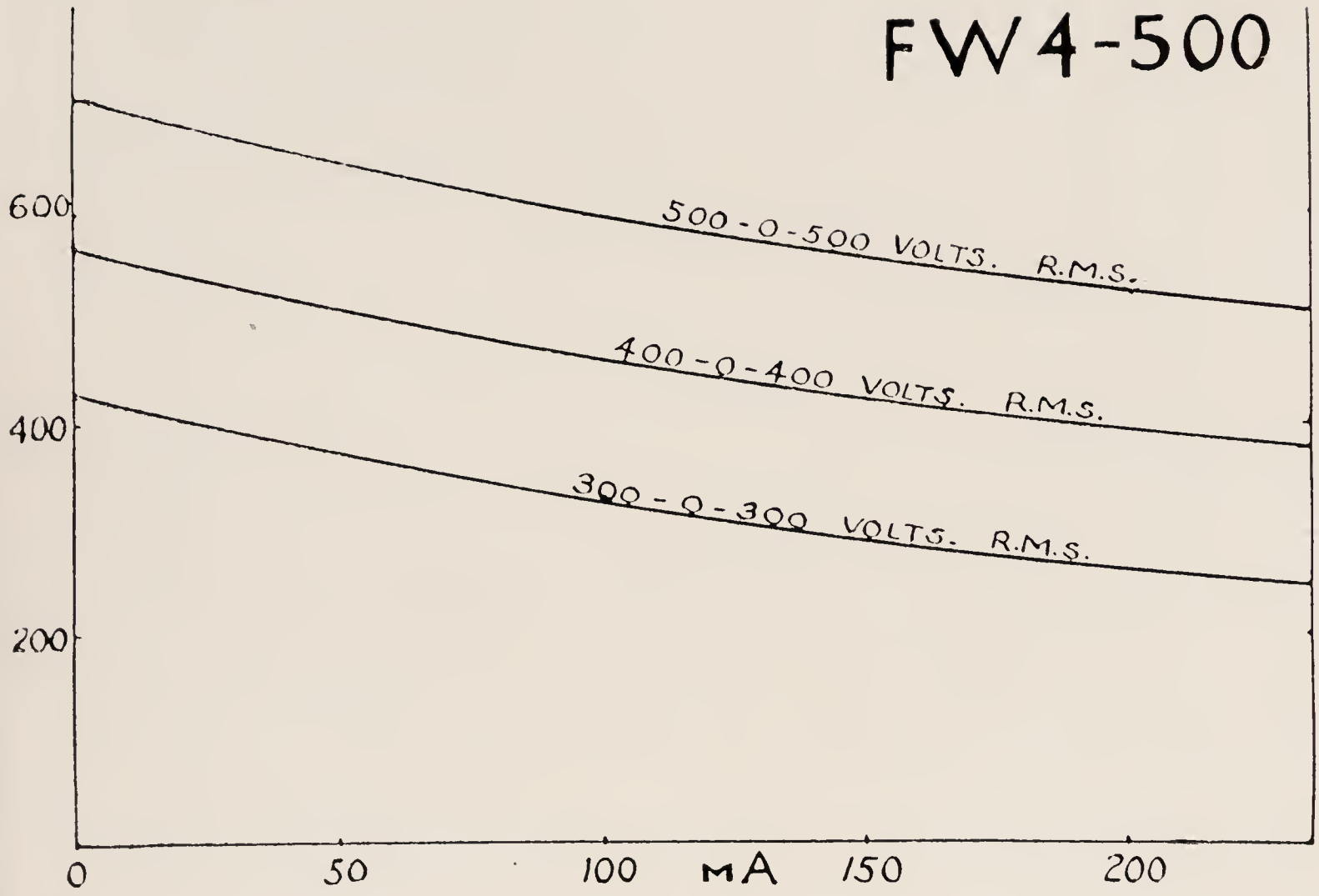

Fig. 11

Characteristic Curve of the Mullard FW4/500 Rectifying Valve.

secondary circuit is small, the coil is of ample carrying capacity, the leads short, forming a throat depth of only a few inches. The upper carriage is held up by spring pressure. The downward pressure is produced by a system of two levers, one of 4:1 ratio which closes the jaws and takes up any discrepancy between different thicknesses of the work and difference in length of electrodes.

Closure is made by spring pressure, and is held in the closed position by a friction ratchet device. The second, a 25:1 ratio lever, applies the necessary contact and forging pressure, the current being fired by a switch when the necessary pressure is obtained. The difficulty of the timing of the current duration and all switching problems of arcing, wear of points, and variation are overcome by using a storage capacity system as used in large industrial machines, Thyratron control, or other electrical device.

These do not suffer from any variation, as does the mechanical time switch on the alternating current at speeds close to and below one cycle. Fig. 9 and Fig. 10 show a system which consists of a condenser charged to a pre-set voltage and discharged across the primary of the welding transformer. The condenser stores energy proportional to the square of the voltage applied.

The energy for any particular weld or series of welds is under control, as the condenser can be charged to one of twelve different voltage values through a rectifyer. Suitable tappings are present on the welding transformer to accept these voltage values.

The rectifying circuit is similar to that used in any wireless set and comprises two Mullard FW4/500 valves which are readily obtainable. Fig. (11). These charge the condenser in 1½ secs. The line current is small, the peak value being less than 2 mps.

The time of the discharge of the condenser through the primary of the welding transformer is short, the actual time varying with the conditions of the weld. It is in the neighbourhood of 1/100 sec. with a condenser of 200 micro-farads.* Pressure is completely under control by a sliding fulcrum and lever assembly which operates when the required pressure is obtained to contact the condenser across the welding transformer.

The three variables, pressure, storage energy and voltage matching are set from a control panel above the upper turret. The actual voltage in the condenser being read on a voltmeter on the same panel. The upper electrode lifts a distance of 1 centimetre to allow easy insertion of the work, and is controlled by a foot pedal from which there emerge two Bowden wires to the system of pressure levers.

The storage condenser is separated from the rest of the welder, and can be placed anywhere within reasonable distance.

A large number of welds were made in different sizes of strip and wire with various settings of pressure, voltage, condenser values, and electrode tip areas, and the welds destroyed by tension, the results obtained forming the data for this paper.

The weld under test was lightly held by a clamp to prevent other than tension forces parallel to the strip from acting upon it, but it is realised that fatigue tests would be more in keeping with conditions obtaining in the mouth.

*The time of the complete surge of current in the welding circuit during the weld was shown by oscillograph to be under 1/100 sec. for 0.05 mm. and 0.15 mm. strip, 1/75 sec. for 0.2. mm. strip and flattened wire, and 1/50th sec. for round wire. The effective heating time is considerably less.

* * *

DISCUSSION

Professor E. S. Friel, referring to the history of the welder described in the paper read by Mr. Parfitt, said that the Education Committee which drew up the reports on undergraduate and post-graduate teaching had passed a resolution, to be sent to the Council, to the effect that a Committee should be appointed to design a welder suitable for orthodontic purposes. The Council had appointed a Committee of three members to carry out that work, the members being Miss Clinch, Mr. Parfitt and himself. Mr. Parfitt had done the greater part of the work.

The President said he had expected Mr. Parfitt to probe the very depths of welding and that expectation had certainly been fulfilled. The illustrations on the screen had shown the welding of wires of 1 mm., and he would like to know whether Mr. Parfitt had any samples of the welding of slightly finer wires, such as wires of 0.6 mm., 0.7 mm. or 0.8 mm.

Mr. Parfitt, in showing the President a sample of a welded 0.7 mm. wire, said that the welding of the finer wires was more difficult. More annealing occurred, and he thought that was because the contact was more difficult to obtain. If he flattened the wire he found it easier.

Mr. H. G. Watkin said that Mr. Parfitt had done a very good piece of work for the Society and for orthodontists in general and they should be very grateful to him for devoting so much time to it.

He thought Mr. Parfitt was on the right lines in using a condenser, because that avoided the trouble of timing the switch with the cycles. He had been very interested in Mr. Parfitt's remarks about the shaping of the electrode tip and thought he was quite right to get rid of the heat where it was not wanted. A good many welds rusted because they were not cooled sufficiently quickly.

He hoped it would be possible to produce the welder at a reasonable price, and he thought that could be done if it was made in large quantities. He was very anxious to have one and to do some experiments with it.

Mr. Parfitt, referring to the condenser, said that the size he used for the heavier wire was 200 microfarads. He had tried various condenser sizes, because the larger the condenser the slower the discharge. For ordinary strip one could have extremely rapid welding ; he had got down well below 1/100 second. With the 200-micro-farad condenser he used a voltage of 800 ; the voltage could be increased to 1,000, but that was a little dangerous for ordinary insulation materials, the ordinary plastic materials. He used an ordinary oil-type condenser, which was large, being at least 1 cubic foot, and heavy. He used that type because he thought it was the safest, but he had learned that the electrolytic condensers were quite satisfactory and that the slight discharge obtained with them did not do any damage. They also had the advantage of being cheap. He had tried a change of capacity, but as the energy stored in the condenser varied as the square of the voltage it was better to alter the voltage, because double the capacity was just double the amount, whereas twice the voltage was four times the amount.

Mr. Norman Gray, in thanking Mr. Parfitt for his very interesting paper, said the Society was fortunate in having members who could deal with electrical subjects for it, because the best orthodontic appliances could be ruined by bad welds. He was afraid that the welder described in the paper would be very expensive, and he would like to have some idea of what it would cost.

One point which had struck him as being very interesting was the flattening of the wires. Did Mr. Parfitt flatten the spring wires before he welded them to the main bars ?

Mr. Parfitt said that he did not flatten the fine wires, because he did not weld fine wires to thick bar, but when he was joining two 1 mm. main bars he flattened them slightly. When he attached the finer spring wires he welded a piece of very fine plate, about 0.15 mm., on to the flattened surface of the 1 mm. bar, thus forming a very fine tube, and he then fixed on the wire.

Mr. Norman Gray asked whether Mr. Parfitt ground the surface.

Mr. Parfitt said he did not grind the surface ; he just tapped it.

Miss K. C. Smyth said she would like to thank Mr. Parfitt for his very interesting paper and to ask him whether he could give some more information about the actual shape and construction of the different electrodes for different purposes. He had mentioned the shape of one type of electrode but he had not described the alternative shapes of different electrodes.

When Mr. Parfitt welded two wires together direct, having previously flattened them, how did he keep them in apposition ? Was there any grooving of the electrodes ?

Mr. Parfitt said that the shape of the electrodes was a very individual matter. Everyone shaped his electrodes to different amounts, and sometimes they had to be carved and ruined for one particular job. He made the lower one spherical and the upper one flat. They had slight misalignment. Turrets were essential for the rapid change of electrodes, but if there were turrets it was difficult to align each one. If one was spherical and one flat, there could be a fair amount of misalignment. The largest electrode tip that he used was about 7 mm. across ; with the smaller ones the cooling was less, but one of 4 mm. or even 3 mm. across, for getting into the corners of the band, had a quite good cooling effect.

If the two 1 mm. wires were flattened, the electrodes fitted closely and one could take one's hands away. If the wires were round and there was only a slight indentation of the electrodes, the electrodes soon became worn. That was why there must be excellent lateral rigidity and thick electrodes. So long as the indentation was deep and fitted the wire, good cooling was obtained. At first one could take one's hands away, but after twenty or thirty welds had been made the electrodes became more and more oval and tended to slip and had to be held with the fingers. The contact resistance increased, the electrodes damaged themselves, and worse welds and more and more annealing were obtained. The electrodes must fit closely if the best possible weld was to be obtained. Mr. Tucker had suggested flattening the electrodes, and that worked very well.

Mr. V. Pedley said he thought that more difficulty was experienced in welding stainless steel after the appliance had been worn in the mouth. If one wished to add pieces of wire to an appliance after it had been in the mouth for some time, was it reasonable that it should be more difficult to do so ? Had the material undergone any change ?

Mr. Parfitt said he thought the difficulty was due to grease and other deposits from the food which was eaten forming on the appliance. He took them off with a disc, and where he wanted to make a weld he cleaned the wire or band with spirit and polished it, and it was then as fresh as it had been before. If one was using the direct method of making an appliance and put in on to the model, there might be plaster on it, also whatever material was used for holding the band on to the model, but that could easily be taken off with chloroform or spirit. It was well worth while looking to the surface and having the metal in as polished a state as possible, in order to reduce the surface contact resistance.

The President, in proposing a vote of thanks to Mr. Parfitt, said he was sure the members were very grateful to Mr. Parfitt for having carried out so successfully the valuable work described in the paper. It was difficult to realise the amount of time and concentration that the work required. He also wished to propose a vote of thanks to Dr. Friel, who he was sure had given valuable advice in the matter.

The votes of thanks were accorded with acclamation, and the meeting then terminated.

* * *

MOVEMENTS OF THE TONGUE IN DEGLUTITION

By Dr. J. WHILLIS

FIRST I SHOULD like to thank you for letting me come here to tell you some of the results that I have obtained from investigating the process of swallowing.* The subject has a bearing on the Presidential Address this year, when a part of the mechanism was demonstrated to you visually. As you know, a great deal of work has been done recently particularly by Barclay and Johnson on the mechanism of swallowing, which has altered our conception of it considerably. The film that I propose to show you is one in which can be seen, I think for the first time, the whole of the tongue movement occurring. The previous investigation was done mainly by means of X-rays, and some of the observations which were made were not really explained in the previous accounts.

I propose first to described briefly the movements which occur in swallowing and explain how they occur, and then I shall show the film twice, because, although it was taken by slow motion photography, it is difficult to see everything on the first showing and I think you will benefit from seeing the film a second time.

The early part of swallowing differs considerably in swallowing solids and in swallowing fluids, and I shall deal first with the swallowing of fluids. When one receives a fluid into the mouth, one either receives it from an ordinary drinking vessel, such as a cup of a glass, or takes it into the mouth through a piece of apparatus, such as a tube or a feeding cup. In the film the patient is drinking from a feeding cup, owing to the difficulty that he had in drinking from an ordinary cup or glass, so part of the mechanism is not evident in the film.

When fluid is taken into the mouth normally the tongue first of all scoops up any fluid which remains on the floor of the mouth. That is done by the sides of the tongue being first turned down and then being turned up again, so that the tongue acts as a sort of scoop. The upper surface of the tongue is grooved, so that there is a tubular space between the palate above and the tongue below, and the fluid is received into that tubular space. The next phase is the squirting of the fluid through the mouth, the action of the tongue as a squirt produced by the effects of the intrinsic musculature. The base of the tongue is fixed by extrinsic muscles, but the main movement is produced by the intrinsic muscles, the most important muscles in that respect being the transverse fibres which are present in the lower part of the tongue.

The tongue works in the closed mouth cavity, so any alteration in its shape is at once effective in altering the shape of the cavity.

The first thing that happens is that the transverse fibres contract, and in contracting they narrow the lower part of the tongue. The tongue must have a more or less constant volume, so that the narrowing of the lower part results in an expansion of the upper part, just as when one part of an inflated balloon is squeezed the rest of it bulges.

Jour. Anat. **80,** Part 3, July, 1946.

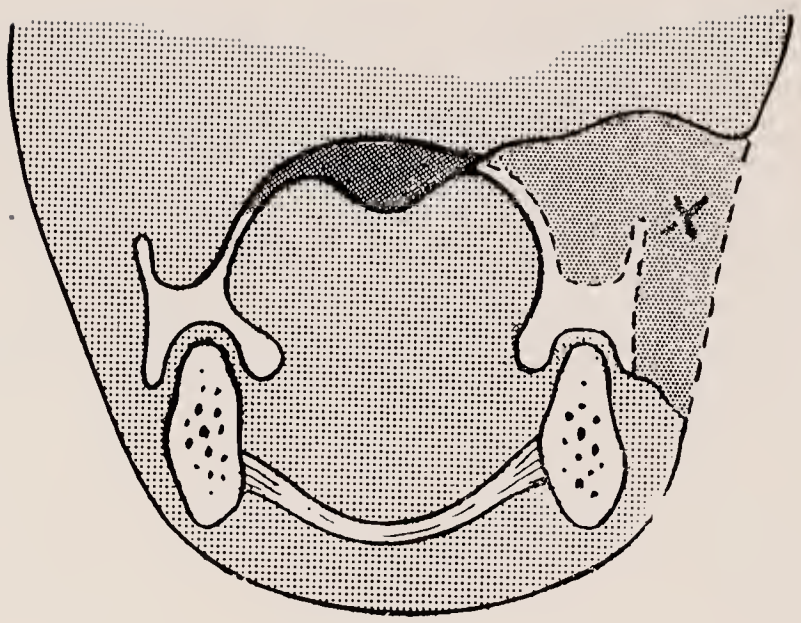

Fig. 1.
Coronal section of the mouth showing the grooved upper surface of the tongue and the tubular space between it and the palate. The stippled area indicates the extent of the deficiency in the tissues.

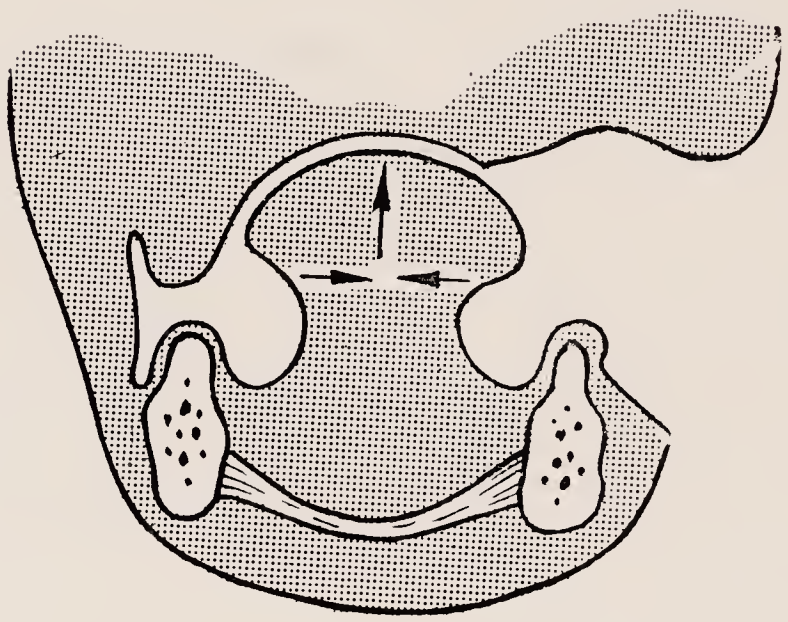

Fig. 2.
Coronal section of the mouth showing the effect of contraction of the transverse fibres of the intrinsic musculature.

The effect is to obliterate the space between the tongue and the palate, the tongue bulges upwards and is narrowed at its lower part, due to the contraction of the lower fibres of the transverse musculative. In the film you will be able to see the grooving which occurs on the side of the tongue due to the local contraction of the muscle in the lower part of the tongue. This contraction of the intrinsic musculature occurs successively from the tip of the tongue towards the base. The first part of the tongue to come into contact with the hard palate is the tip, and then the fibres just behind the tip contract and squeeze that part of the tongue up. This process occurs successively from the front to the back of the organ, so that there is a sort of ripple over the upper surface of the tongue, which was shown quite well in the earlier radiological investigation of this problem.

By means of the obliteration from the front to the back of the mouth of the space between the tongue and the palate, the fluid is squirted to the back of the mouth. In the film I have called this Phase 1.

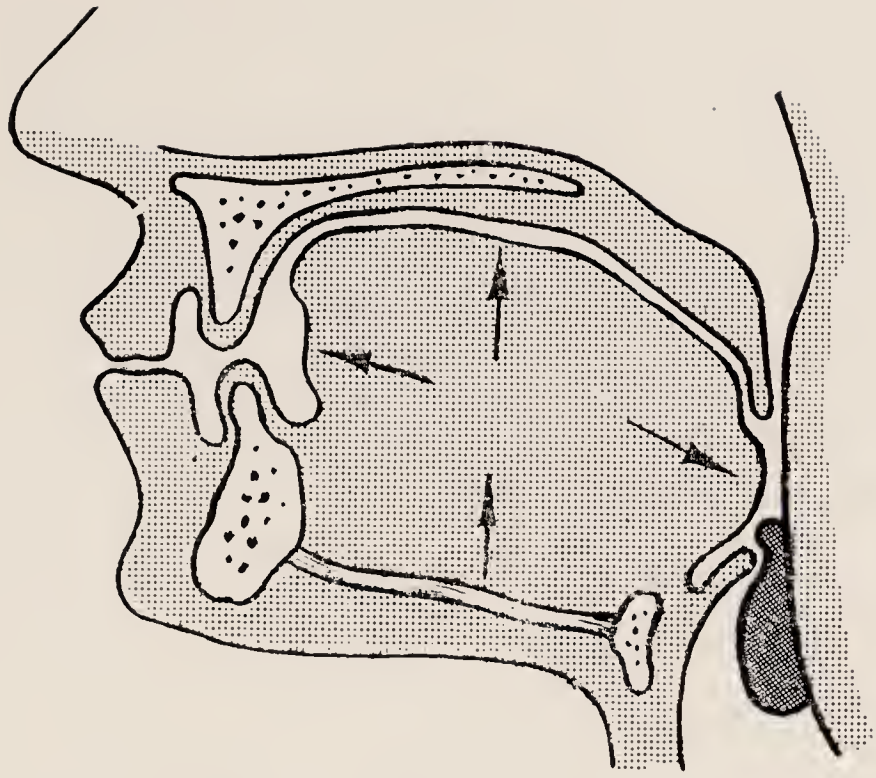

Fig. 3.
Sagittal section of the wouth showing the effect of the mylohyoid in phase 2.

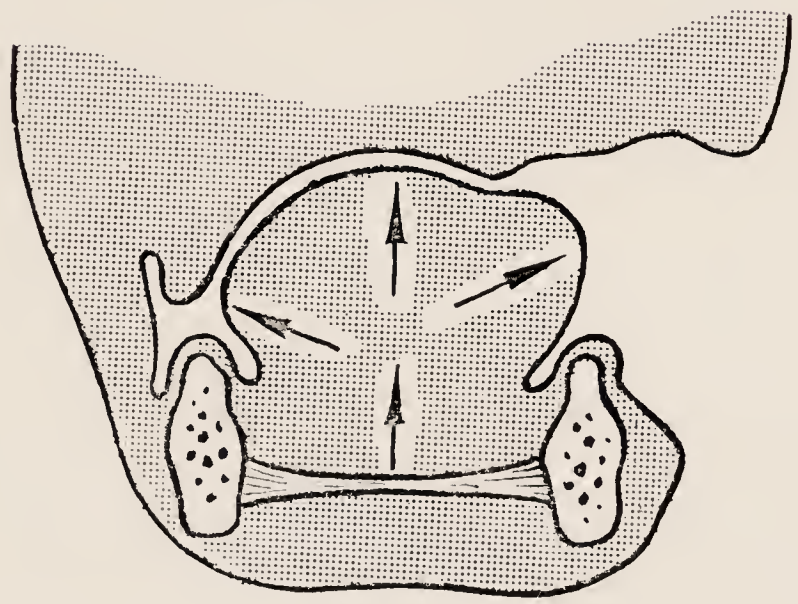

Fig. 4.
Coronal section of the mouth showing the effect of contraction of the mylohyoid in the patient with the deficiency in the cheek.

Phase 2 is produced by the mylohyoid muscle. Again the tongue is lying in the closed cavity of the mouth, and contraction of the mylohyoid muscle squeezes the tongue. The only way in which the tongue can bulge in a normal position for swallowing, that is to say, with the teeth in occlusion, is backwards into the pharynx, and this backward bulging into the pharynx completely obliterates the space in the oral pharynx and so transfers the fluid back into the pharynx.

In the swallowing of solids, Phase 1 does not occur as a rule. It is used in the swallowing of solids merely to clear the mouth of saliva and debris after the bolus has been swallowed. The movements of mastication, including the movements of the tongue, have carried the bolus towards the back of the mouth already, and all that is necessary is for it to be squeezed back into the oral pharynx by Phase 2, that is, the contraction of the mylohyoid muscle squeezing the tongue and so bulging it back into the pharanx.

The man shown in the film had had an extensive neoplasm of the cheek and successive attempts had been made to remove it, so he was left with a very wide gap in the teeth, and I should like

to indicate the extent of that gap, so that you can have some idea of what you are going to see. The alveolar margin of the upper jaw had been removed almost completely on one side.

The whole of the cheek had gone from the zygoma to the lower jaw, so that the alveolus of the lower jaw could be seen. In one place there was actually an opening into the maxillary sinus, and a little black streak, which is the cavity of the antrum, could be seen. The tongue, therefore, in the second phase of its movement in swallowing was free to bulge out through that gap, in much the same way as it was free to bulge out in the gap between the incisor teeth in the case of the children of whom the President showed a film earlier this year, who swallowed without the teeth being brought into occlusion. This bulging of the tongue occurred only during the second phase, that is, the phase of the contraction of the mylohyoid, and if you look alternately at the tongue and at the region just below the jaw you will be able to see that coincidence. If you try to see both things at once you will fail completely, because you cannot watch the tongue and the mylohyoid at the same time. That is one of the reasons why I want you to see the film twice.

The film was then shown.

* * *

DISCUSSION

The President said he was surprised at the frequency with which the swallowing action was performed in eating, as shown in the film.

Dr. Whillis said he thought that was probably an unusual feature of the case shown in the film. The man was completely edentulous ; he could eat only the softest bread and butter and had a little difficulty even with that, so he was apt to chew it and swallow it in very small pieces. A normal person would make many fewer movements than he did.

Mr. K. E. Pringle said he had been impressed by the power of the tongue to prevent leakage.

Dr. Whillis thought that was a feature which was not noticed normally in the ordinary mouth. Very little leaked past the tongue and the buccinator in the effort to keep food between the teeth and in the mouth cavity. The clearance produced by the buccinator in an ordinary mouth was very little, as hardly anything accumulated for it to clear out, and he thought it was the same with the tongue. He had asked the man shown in the film whether he had had to learn to control leakage, and he said that was not the case, as from the beginning he had been able to control it.

One interesting point was that in speaking the man still used lip movements, althought most of the air escaped through the gap. In the production of vowel sounds like " ah " he opened his mouth quite as much as an ordinary person would do. He had not adapted himself in any way to his new conditions in that respect. He still used the same mechanism as he had used before he got the gap. Probably the same was true of the tongue.

Mr. J. W. Schofield asked whether the parotid was destroyed on the side of the man's face on which there was the gap.

Dr. Whillis replied that the anterior part of the parotid had certainly gone, but he had not been able to obtain a complete history of the actual operative procedure, so he could not say definitely whether the whole gland had been destroyed. From observation of the surrounding granulation tissue, he would say that the parotid duct was completely occluded, and he thought the gland must have gone. In addition to having numerous operations, the man also had two or three courses of radium, and the parotid had probably been destroyed by the time the film was taken.

Mrs. Lindsay suggested that through loss of the cheek the man's tongue had become practised in controlling leakage.

Dr. Whillis said the man had told him that he had not noticed any difference from the very beginning, that he had been able to control leakage from the start.

Mr. G. J. Parfitt asked whether Dr. Whillis had studied the pressures involved in the case shown in the film or in normal cases. He had always thought that in the act of swallowing there was a considerable pressure as the tongue was pressed towards the front of the mouth, and that there was possibly a definite sucking effect of the lips, cheeks, and so on. He thought there was a pressure against the hard tissues, the teeth, etc., concomitant with a muscular pressure from the teeth on the inside.

Dr. Whillis said he had not studied the pressures at all in the case of the man shown in the film, because he had secondaries in the lungs at the time when the film was taken and it would not have been justifiable to subject him to anything further.

At the moment he was investigating pressure effects in sucking. From the literature he gathered that the question of intra-oral pressure was somewhat controversial, and the pressures developed by the falling away of the tongue from the palate, and so on, were being investigated. As far as the actual swallowing movements of the tongue were concerned, he had not investigated the pressures at all, but the pressure during the mylohyoid phase must be fairly considerable. He thought that the pressure developed by the intrinsic movement of the tongue was quite small, because the way out for the fluid, or whatever it might be, was quite free, but the tubular space between the tongue and the palate went right to the back of the mouth, so he did not think that until the operation was over there would be an actual suction exerted between the tongue and the palate. He did not think the pressure during that phase would be very high. It was in the mylohyoid phase that the pressure rose, as was fairly obvious from the fact that the tongue must bulge.

The film was then shown a second time.

Dr. Whillis : I now wish to say a few words about the epiglottis and the backward bulging of the tongue. There is a good deal of controversy about what happens to the epiglottis in the act of swallowing. Some observers say that it bends so that its convexity becomes greater and the bolus passes across the dorsal surface of it and on into the pharynx. Johnson has recently taken a number of radiographs which show the epiglottis bending like a lid over the superior laryngeal aperture. This has led to a good deal of argument about which does occur. I think that it depends on what is being swallowed. If the bolus is of a fairly stiff consistency and the person

swallowing it has a long epiglottis, the epiglottis may be caught by the bolus as it is pushed back by the tongue into the pharynx, and it will then act as a lid over the larynx. but, if it is a liquid that is being swallowed and the person swallowing it has a short epiglottis, the epiglottis will merely bend due to the rising of the laryngeal skeleton.

I propose to show you on the screen two X-ray pictures, one taken at rest and the other during the height of the mylohyoid phase of swallowing, showing the backward bulging of the tongue, the obliteration of the oral pharynx by the tongue and the ordinary position of the epiglottis when fluids are swallowed. I think the catching of the epiglottis by the bolus, to which I have referred, may be purely mechanical. When one looks at a number of specimens of the epiglottis, one finds a very great variation in the degree to which it projects and a considerable amount of variation in the thickness and resilience of the epiglottis itself, and I think that is enough to account for the differences which are seen by various observers in taking X-ray pictures of the epiglottis during swallowing.

Mr. H. Chapman said that in the case of some children who were wearing apparatus food collected between the outer portion of the alveolus and teeth and the cheek. The children did not seem to know that it was there and did not seem able to clear it out at all. He would like to know whether Dr. Whillis could explain that.

Dr. Whillis asked whether the apparatus was likely to interfere with the mechanism of the buccinator.

Mr. Chapman said it was hardly more than a single piece of wire at about the level of the necks of the teeth.

Dr. Whillis thought that, from personal experience of what happened inside his own mouth, only a very small interference with the normal configuration of the teeth, gums, and so forth, was needed to have a great effect on the mouth. It might be that even the presence of the small wire interfered to some extent with the normal mechanism of the buccinator. He thought the fact that the children were not conscious of the presence of the food was of importance. They were at first conscious of the presence of an abnormality—the apparatus—inside the mouth and they tried as hard as they could to disregard it, and, after doing that for a considerable time, they disregarded the normal stimuli. If the pharyngo-palatine and glosso-palatine arches were painted with a brush over a considerable period of time, the pharyngeal reflexes could be nearly abolished. He would say that the interference with the buccinator was of that nature, but he could not be sure until he had seen what was happening in the child's mouth.

The President suggested that the children to whom Mr. Chapman had referred might swallow abnormally through not having their teeth shut when they swallowed and their swallow might not be such a detergent swallow as when the teeth were closed, with the result that the upper cavity was not cleared so completely.

Dr. Whillis said the children might get more into the upper cavity to start with, owing to the fact that the jaws were not in occlusion.

Dr. Whillis then showed the two X-ray photographs.

The President said that the members had listened to an extremely interesting discourse from Dr. Whillis and had seen some unique cinematography. A knowledge of the physiology of the mouth and tongue was of the utmost importance to orthodontists, and he was sure that Dr. Whillis had added to that knowledge on the present occasion, so the members were indeed grateful to him. There was a tendency, he feared, for orthodontists to concentrate their attention too closely upon concrete things like teeth and bones and to ignore the more obscure factor of physiology, but function affected form, and no study of malocclusion which was concerned solely with the relations of the dentition in space would prove complete. Plaster casts and teleradiography were only part of the story.

He would like to ask whether Dr. Whillis had formed any idea as to the time in life when the type of swallow which required the teeth to be put in occlusion was established. A baby did not put its gum pads into occlusion when it swallowed, and he thought that even when its teeth were newly erupted it did not put them into occlusion during swallowing. Judging from Broadbent's teleradiographs, he thought that the tooth-shut swallow was not adopted until about the age of 3 years, but he would like to know whether Dr. Whillis had any more definite information on that point. It was interesting to see that the edentulous man shown in the film did not put his gum pads together when swallowing.

He would also like to know whether Dr. Whillis could give any information on the question of lisping. In some work that he had done, on which he had written a paper, he had noticed that it was amongst the children who swallowed abnormally, with their teeth separated, that one occasionally found a lisp. He had never found a lisp except in children with an abnormal swallow. He wondered whether Dr. Whillis knew of any underlying conditions which were favourable to a lisp. A child's imitative faculties normally caused it to grow out of lisping, but there was no doubt that in some cases it was particularly difficult for the child to grow out of the habit and in other cases it was impossible. There must be some underlying special difficulty in the case of those children, and he would like to know what it was.

The film had shown very clearly the great thrust of the tongue at the moment of the contraction of the mylohyoid muscle, and that gave some idea of the amount of centrifugal force that was transferred to the dental arches when the teeth were in occlusion during that action.

Dr. Whillis said he had no personal experience of most of the questions raised by the President and therefore found difficulty in answering them. He would be reluctant to state a definite age at which children began to do certain things, because the age varied very greatly in different children, but he thought the average age at which occlusion was noted as an accompaniment of swallowing was 2 to 3 years. During the period of milk feeding there was no necessity for occlusion, and the normal mechanism of swallowing fluids had marked differences from that of swallowing solids ; for instance, the pharyngeal effort and the oesophageal effort were quite different. In the swallowing of fluids, the fluid was generally squirted into an open and empty oesophagus. He thought, however, that the habit of swallowing with the teeth not occluded persisted long

after the period of fluid feeding was over, and the process of changing to swallowing with the teeth in occlusion was a gradual one.

He was afraid that he had no information to give on the subject of lisping.

Mr. H. R. Markham asked whether there was any truth in the suggestion that fluids were sometimes poured straight into the stomach.

Dr. Whillis said that in that connection there was a considerable variation in different people. He had investigated the matter in people who took a pint of beer and poured it straight down. He had found that, in drinking large quantities of fluid (in this case it was barium and not beer), some people held a considerable quantity of it in the oesophagus for some time—the oesophagus seemed to be capable of dilating to an enormous extent—whereas in the case of other people the fluid proceeded straight through into the stomach. He had observed that people with good muscular development tended to hold fluid in the oesophagus a little longer than people with poor muscular development held it there. He did not know whether that had anything to do with the diaphragm, but it would appear that it had.

A fluid could be held in the oesophagus for several seconds before it went into the stomach, and the oesophagus appeared to be completely relaxed in that effort.

Miss K. C. Smyth asked why some people could swallow large pills quite easily whereas other people could not swallow even small pills.

Dr. Whillis said he thought the reason was partly psychological, the ease or difficulty in swallowing pills depending upon whether or not they were in jam. There were, however, people who had exaggerated reflexes through the whole of the alimentary tract, and he thought that was at the bottom of most of the difficulty. The pill stuck somewhere in the neighbourhood of the laryngeal aperture, and that accentuated the reflex responses and added to the difficulty.

Miss R. Caseley asked whether, in the development of the maxilla, the contracted maxilla or the lack of action of the tongue came first. Which was the cause and which was the effect ?

She would also like to know whether the action of swallowing had been modified since the days of anthropoid man. In the anthropoids the mylohyoid was in the region of the last molar, or appeared to be so in the skulls of anthropoids that she had examined, whereas now the mylohyoid extended forward.

Dr. Whillis said that he could not answer the second question. In answer to the first question he could only say that the two conditions to which Miss Caseley had referred were often associated. He did not know which was the cause and which the effect, and he doubted whether anyone knew.

On the motion of **The President,** a vote of thanks was accorded to Dr. Whillis and to all those who had taken part in the discussion.

The Retiring President said that the time had now come for him to leave the dias for the seclusion and comfort of the body of the hall.

During this first year of peace there had been a very welcome return of many of the members to London, and the other London members were delighted to have them back. There had also been a gratifying increase in the membership of the Society. That was a sign that more interest was being taken in the young, with the result that the community would be better served and orthodontists would obtain more gratification from their work.

He thanked the Council and other members of the Society for the support and courtesy they had shown him during his year of office in a position which had been occupied by worthier men than he. There was no one to whom he would be more pleased to hand the badge of office than Mr. Cutler, who had identified himself untiringly with the interests of the Society for many years. The members were happy in the knowledge that they would have Mr. Cutler as their wise and forceful President during the coming year.

Mr. Cutler was then invested with the badge of office by the retiring President and took the Chair.

The President, in moving a vote of thanks to the retiring President for his services during the past year, said he was glad that an opportunity had not yet been given for anyone in the hall to express his appreciation of those services, because he wished to be the first to do so. Mr. Rix and he had been students over twenty years ago, and he could remember how in those happy sunlit days they used to play tennis in each other's gardens and talk to each other about the way in which, in later years, they might prize open the oyster of worldly success. In that aim Mr. Rix had amply succeeded, but in doing so he had never lost any of that modesty and charming diffidence of manner which denoted the true Englishman and which Englishmen recognised so well in one another, a diffidence which covered a wealth of knowledge and singleness of purpose. It was a quality not often recognised by people in Europe, and on more than one occasion it had led to the dismay and undoing of our late enemies.

Mr. Rix was the Director of the Dental Department for Children at Guy's Hospital, and the knowledge and experience which he had accumulated there he had put freely at the disposal of the Society, both in the presenting of papers and in the committee work that he had done on the Council behind the scenes. It was fortunate for the Society that, as immediate Past President, Mr. Rix would remain on the Council for one year, and it was hoped that he would continue on the Council thereafter, so that the Society would still have the benefit of his support and advice. Mr. Rix had presided over the meetings of the Society with dignity and had exercised a firm discipline over his unruly children on the Council, without affronting the personal pride of any one of them.

Mr. Russell Marsh, in seconding the vote of thanks, said that all the members were conscious of Mr. Rix's charm and the common sense as well as learning that he brought to his work. During Mr. Rix's term of office the Society had had one of the most successful years in its history, and it was no exaggeration to say that he was an outstanding figure in the Society's long line of illustrious Presidents.

The vote of thanks was accorded with acclamation, and the meeting then terminated.

* * *

REPORTS OF MEETINGS

An ordinary Meeting of the Society was held at Manson House, 26 Portland Place, London, W.1, on Monday, January 7th, 1946, at 6 p.m. The President, Mr. R. E. Rix, occupied the Chair.

The Minutes of the last meeting, held on December 3rd, 1945, were read and were confirmed and signed.

The following candidates for membership, approved by the Council, were elected *en bloc* :—

Cyril D. Baker, L.D.S., 47 Highcilffe Gardens, Ilford, Essex ;

James Johnstone, L.D.S., 7 Portland Square, Carlisle ;

Miss Dorothy Young, L.D.S., 55 Eton Rise, Eton College Road, N.W.3.

The President said he would like to welcome any visitors who were present. He also wished to say that the Council would be very glad to receive offers to take part in the Demonstration Meeting to be held in May.

* * *

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, February 4th, 1946, at 6 p.m. The President, Mr. R. E. Rix, occupied the Chair.

The Minutes of the previous meeting, held on January 7th, 1946, were read and were confirmed and signed.

The following newly elected members were introduced to the President :—Mr. David Baker, Mr. Clarke and Miss O. Young.

The following candidates for membership of the Society were elected *en bloc* :—

Geoffrey H. H. Ames, M.R.C.S., L.R.C.P., L.D.S., 252 Ballards Lane, N.12.

Norman A. Buck, L.D.S., 25, Chalkhill Road, Wembley Park, Middlesex.

James H. Glen, L.D.S., 36 King's Avenue, Bromley, Kent.

Keith R. Titford, B.D.S., L.D.S., Kingsmead, De Tillen's Lane, Limpsfield, Surrey.

James W. Softley, B.D.S., 25 Druidsville Road, Liverpool, 18.

The President welcomed any visitors who might be present and expressed the hope that, if they so desired, they would take part in the discussion which would follow the papers.

* * *

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, March 4th, 1946, at 6 p.m. The President, Mr. R. E. Rix, occupied the Chair.

The Minutes of the last meeting, held on February 4th, 1946, were read and were confirmed and signed.

The following recently elected members were introduced to the President, who admitted them as members of the Society:— Mr. Hamish Anderson, Mr. James Glen.

The following candidates for membership of the Society were elected *en bloc* by show of hands:—

H. Patcas, Langstraat, 77, Antwerp Borgerhout, Belgium, (Corresponding Member);
Edgar K. Breakspear, L.D.S., Central School Clinic, Gulson Road, Coventry;
John D. Hooper, L.D.S., Stanlow, Balcombe Road, Haywards Heath, Sussex.
Sidney G. McCallin, L.D.S., 44, Sloane Street, London, S.W.1.;
Miss Mary K. Scott, L.D.S., 73, Home Park Road, Wimbledon, S.W.19;
Walter N. Trays, 3, Downs View, Bude, Cornwall.

The President welcomed the visitors present and expressed the hope that they would take part in the discussion which would follow the paper.

* * *

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, October 7th, 1946, at 8 p.m. The President, Mr. E. E. Rix, occupied the Chair.

The Minutes of the Ordinary Meetings held on March 4th, 1946, and May 6th, 1946, were read and were confirmed and signed.

The President announced with deep regret that since the last meeting Mr. George G. Campion, a distinguished member and Past-President of the Society, had passed away. Throughout the whole of his professional career, which began as long ago as 1885, Mr. Campion's rare qualities found expression in many spheres of activity. He made valuable contributions to the literature of both dentistry and philosophy. Orthodontics was a special interest of his, to which his writings on facial growth and dental development bore witness. As recently as their last meeting the members of the Society had been privileged to hear a communication from him dealing with those subjects. On behalf of the Society, the Secretary had written a letter of condolence to Mr. Campion's family.

Mr. Briggs and Mr. J. O. Hooper were introduced to the President and admitted by him to membership of the Society.

The following candidates for membership of the Society were elected *en bloc* by show of hands:—

Lucien De Coster, Rue Archimède, 1a, Brussels, Belgium, (Corresponding Member);
Albert Beauregardt, 8, de Camoens, Paris, France, (Corresponding Member);

Arthur Baker, L.D.S., 11, Church Crescent, Dumfries, Scotland ;
Jack S. Beresford, L.D.S., 11, Pembridge Place, W.2 ;
E. Barrington Briault, L.D.S., 2, Upper Wimpole Street, W.1 ;
Brian T. Broadbent, L.D.S., Turner Dental School, Manchester ;
Christopher C. Bull, 13, Magdalene House, Manor Fields, Putney, S.W.15 ;
Mrs. Muriel E. H. Davis, L.D.S., 8, Prospect Road, Moseley, Birmingham, 13 ;
Ronald D. Emslie, B.D.S., L.D.S., 12, Gloucester Place, W.1 ;
George R. Down, L.D.S., 9, Harley Street, W.1 ;
Ronald D. G. Gain, L.D.S., 178, The Rye, East Dulwich, S.E.22 ;
George E. M. Hallett, H.D.D., L.D.S., 12, Elmsway, Bramhall, Cheshire.
William U. Harwood, L.D.S., 21, Second Avenue, Hove 3, Sussex ;
T. Cradock Henry, M.R.C.S., L.R.C.P., L.D.S., 31, Portland Place, W.1 ;
Alan Kinghorn, L.D.S., 23, Caterham Road, S.E.13 ;
Rudolf Klein, L.D.S., 9b, Porchester Road, W.2 ;
Gerald N. Lewin, L.D.S., 34, Devonshire Place, W.1 ;
Kenneth P. Liddelow, H.D.D., L.D.S., 80, Carshalton Road, Sutton, Surrey ;
J. Ian McCracken, L.D.S., 27, Princes Avenue, Liverpool, 8 ;
Hugh C. L. Maister, L.D.S., 37, Hersham Road, Walton-on-Thames, Surrey (now in Cape Town) ;
Moriz A. Tischler, L.D.S., 3, Park Crescent, W.1 ;
R. Stockman Vine, L.D.S., 143, Station Road, Chingford, E.4 ;
Thomas C. White, L.R.C.P., L.R.C.S., L.D.S., 286, Bath Street, Charing Cross, Glasgow, C.2.

The President welcomed any visitors who were present and expressed the hope that they would take part in the discussions if they desired to do so.

* * *

An Ordinary Meeting of the Society was held at Manson House, 26, Portland Place, London, W.1, on Monday, November 4th, 1946, at 8 p.m. Mr. R. E. Rix, President, occupied the chair.

The Minutes of the previous meeting, held on October 7th 1946, were read and were confirmed and signed.

The following candidates for membership of the Society were elected *en bloc* by show of hands :—

Geoffrey H. Gilbert, Christchurch, New Zealand (Corresponding Member) ;
Maurice M. Williamson, Nakuru House, P.O. Box 120, Nakuru, Kenya Colony (Corresponding Member) ;
Joseph Angelman, 41, Rodney Street, Liverpool, 1 ;
Mrs. Mary L. Copleton, 67, Clifton Terrace, Newtown, Montgomeryshire, ;
Jeffrey S. Rose, 34, Allandale Avenue, N.3.

The President welcomed any visitors who might be present and expressed the hope that they would take part in the discussion to follow the paper, if they desired so to do.

The following newly elected members were introduced to the President, who admitted them to membership of the Society:— Messrs. G. R. Down, G. E. M. Hallett, R. Klein, S. G. McCallin, J. S. Rose, J. W. Softley, J. S. Beresford, R. D. G. Gain, G. H. Gilbert, R. B. Dockrell and R. D. Emslie.

* * *

ANNUAL GENERAL MEETING

The Annual General Meeting of the Society for the year 1946 was held at Manson House, 26, Portland Place, London, W.1, on Monday, December 2nd, 1946, at 8 p.m. The retiring President, Mr. R. E. Rix, occupied the Chair.

The Minutes of the previous meeting, held on November 4th, 1946, were read and were confirmed and signed.

The President announced with deep regret the death of Sir Frank Pearce, one of the Society's most distinguished members, whose whole career was pursued with unobtrusive energy and kindness. His academic attainments were of the highest order. He devoted himself wholehearted to the service of the dental profession at large and richly deserved the knighthood that was conferred upon him in 1939. As one who at one time had come into close contact with Sir Frank Pearce, he could testify to his consideration and kindness. The dental profession had sustained a great loss in his death.

The members would wish to offer their deep sympathy to Lady Pearce and her family, and on their behalf Mr. Pringle had already written a letter of condolence to Lady Pearce.

The following new members were introduced to the President and admitted by him to membership of the Society : Mr. Broadbent, Mr. W. U. Harwood and Mr. M. A. Tischler.

ELECTION OF OFFICERS AND COUNCILLORS

There having been no other nominations, **The President** declared the following to be the Officers and Councillors of the Society for the year 1947 : President : Mr. R. Cutler ; Immediate Past President : Mr. R. E. Rix ; Vice-Presidents : Professor M. Rushton, Mr. L. R. Marsh, Mrs. L. Lindsay ; Secretary : Mr. K. E. Pringle ; Treasurer : Mr. H. Chapman ; Curator : Miss L. M. Clinch ; Editor : Mr. J. F. Pilbeam ; Librarian : Mr. A. G. Taylor ; Councillors : Mr. C. F. Ballard, Mr. G. J. Parfitt, Mr. C. L. Endicott

ELECTION OF TWO AUDITORS

On the motion of **Professor M. Rushton,** seconded by **Mrs. Lindsay,** Mr. W. L. Boness and Mr. S. B. Newton were unanimously re-elected Honorary Auditors of the Society for the ensuing year.

REPORT OF THE HONORARY TREASURER

The Hon. Treasurer (Mr. H. Chapman) said that provision had been made for the publication of three years' Transactions, 1944 and 1945 in one volume, and 1946. If provision had been made for one year's Transactions, the excess of expenditure over income would have been approximately £60. The sum of £50 had been invested in Consols. The recurring expenses had increased considerably over those in 1945. Nineteen new members had been elected in the last financial year, which ended on September 30th last. A larger number had already been elected in the current financial year, but it was uncertain whether the increase in income would keep pace with the increase in expenditure. As the Treasurer, he would prefer there to be a definite surplus each year, particularly as the Society might have to face increased expenditure in connection with the Transactions.

He moved the reception of his report.

Mrs. Michaelis seconded the motion, which was carried.

Mr. L. Levien asked what was the usual excess of income over expenditure, taking the average.

Mr. Chapman replied that until the last few years there had not been an excess of expenditure over income. There had always been an excess of income over expenditure ; otherwise the Society would not have investments totalling nearly £1,000. For about three years during the war there had been no subscriptions payable. In the past provision had not been made in advance for the Transactions, but provision had now been made for the Transactions up to and including the year 1946.

Mr. Levien asked whether the money which was provided for the Transactions had actually been spent yet.

Mr. Chapman said that it had not been, as the Transactions had not yet been published.

Mr. Levien said he would like to know for his own information, as he was a Treasurer himself, whether the sum should be shown as an expenditure as it had not been spent yet.

Mr. Chapman said that as Treasurer he was not concerned with that point, but the professional Auditors and the Honorary Auditors had approved it. He took it that it was a case of coming into line with the companies that provided for income tax now in the year in which it became due. As a matter of fact, the arrangement was only a paper one. The cash in the bank at the moment was just over £200, so a considerable proportion of the cost of the Transactions could be paid from that. They would probably cost more than £150, as printing costs were continually increasing.

Mr. O. N. Catchpole asked whether the subscription was the same now as it had been before the war.

Mr. Chapman said it was the same now as it had been before the war of 1914/18. Moreover, for about three years during the recent war no subscriptions had been payable, as he had said, but during those years there had been expenses in connection with meetings and other expenses that had to be met.

Mr. A. L. Packham asked what the item on the righthand side of the balance sheet under "Furniture," "To October, 1944, £621," represented.

Mr. Chapman said that it represented the three cabinets which were now in the Institute of Hygiene, next-door to Manson House. The other furniture had been sold, with the exception of a desk, which was also in the Institute of Hygiene. The insurance on the three cabinets was now being increased and they were being insured for £1,000. It would not be possible to replace them for less than £333 each. Their original cost had been about £100 each.

Mr. L. Levien asked whether the question of purchasing an epidiascope had been considered.

The President said the question had been under discussion for some time. The purchase of an epidiascope was being held up owing to the difficulty of obtaining the kind that was wanted, but as soon as an epidiascope of that type could be obtained it would be purchased.

On the motion of **Mr. L. Levien,** seconded by **Mr. P. G. Oliver,** the report of the Honorary Treasurer was adopted.

REPORT OF THE HONORARY SECRETARY

The Hon. Secretary (Mr. K. E. Pringle) said that the Society's membership had increased greatly during the past year. In December, 1945, it stood at 247, whereas to-day (including the candidates for election at the present meeting) it was 304. Sixty new members had been elected during the year. Three members had died and two had resigned, and the names of a very small number of members had been removed from the List of Members owing to non-payment of subscriptions.

The meetings had been well attended, the average number signing the attendance book being 57. He would remind members and visitors that they should sign the attendance book. Apart from other considerations, it was very difficult to calculate the numbers likely to require refreshments if that was not done.

He thought that Miss Wenyon and her staff should be congratulated for their excellent attention to the Society's needs during the past difficult year.

Speaking personally for a moment, he would like to thank Mr. Robert Cutler most warmly for the way in which he had helped him to understand the manner in which the Society worked. He also wished to thank Mrs. Lindsay for her excellent work as Programme Secretary and the whole Council for their kindness to him as a newcomer.

He moved the reception of his report.

Professor M. Rushton seconded the motion, which was carried.

On the motion of **Mr. H. Chapman,** it was agreed that a letter should be written to Miss Wenyon expressing the members' appreciation of all that she had done for their comfort during the past year.

Mr. Trevor Johnson moved that the Honorary Secretary's report be adopted.

The motion was seconded by **Mr. O. N. Catchpole** and was carried.

REPORT OF THE HONORARY LIBRARIAN

The Hon Librarian (Mr. A. G. Taylor) reported that since the Library had been housed at the Institute of Hygiene it had been a little difficult to obtain books from it after 4 o'clock in the afternoon, so in order to facilitate borrowing he had kept a set of the Transactions and the current orthodontic journals at his home, those being the publications that the members most frequently desired to borrow.

During the past year gifts of books had been received from Mrs. Lindsay.

The Library had hardly been used at all during the war, but recently there had been a progressive increase in its use, and he was glad to say that no member had failed to return a book.

The journals to which the Society subscribed were the Journal of the American Dental Association, the American Journal of Orthodontics and Oral Surgery and the Angle Orthodontist.

He moved that his report be received.

Mr. R. Cutler seconded the motion, which was carried.

On the motion of **Mr. P. G. Oliver,** seconded by **Mrs. Lindsay,** the report was adopted.

REPORT OF THE HONORARY CURATOR

The Hon. Curator (Miss L. M. Clinch) said that the Museum was housed at the Royal Institute of Public Health and Hygiene, 28, Portland Place. Models had been received during the past year from Miss Smyth and Sir Frank Colyer. An attempt had been made to arrange the models according to the classification suggested by Dr. Northcroft in a paper read to the Society in 1935. One drawer had been left in Mr. Chapman's cabinet for each of the classes mentioned by Dr. Northcroft, and there was at least one specimen of each class now in the Museum.

The Museum was open from 9.30 to 5.

A collection of photographs of Past Presidents of the Society was being made. Sixteen photographs had already been obtained, and it was proposed to have an album for the photographs in the Museum when the collection was complete.

She moved the adoption of her report.

The motion was seconded by **Mr. A. G. Taylor** and was carried.

PUBLICATION OF THE TRANSACTIONS

The President invited Mr. Pilbeam, the Honorary Editor, to tell the meeting some of the difficulties he had experienced in connection with the publication of the Transactions.

The Hon. Editor (Mr. J. F. Pilbeam) said he much regretted that, owing to the shortage of paper, the Transactions for 1944 and 1945 had not yet been published. It had been hoped to publish them many months ago, but *The Dental Record*, which printed the Transactions, had had no paper to spare for the purpose. The Society had applied to the Paper Controller for a special permit for the paper in bulk but had not yet been successful in obtaining it. He assured the meeting that every effort had been made to obtain the paper and that the Transactions would be published as soon as it could be procured.

The President said that the best course the Society could adopt was to leave the matter in Mr. Pilbeam's hands, as he was pursuing it very energetically.

ELECTION OF MEMBERS

The following candidates for membership of the Society were elected *en bloc* by show of hands :—

Ian M. Chisholm, L.D.S., Droxford House, Charles Road, St. Leonards-on-Sea ;
Norman F. Clarke, L.D.S., 140, Harley Street, W.1. ;
Gordon C. Dickson, L.D.S., 9, Spen Drive, West Park, Leeds, 6;
Miss Jean R. Forrest, L.D.S., S.C.C. Clinic, 25, Presburg Road, New Malden, Surrey ;
William Grossmann, L.D.S., 79, Harley Street, W.1 ;
Arthur M. Horsnell, M.R.C.S., L.R.C.P., L.D.S., 35, Devonshire Place, W.1 ;
Maurice A. Kettle, L.D.S., 40, Harley Street, W.1 ;
Miss Rachel I. Mears, L.D.S., 1, Adelaide Terrace, Dundee ;
Thomas McNamara, L.D.S., 84 West Ham Place, Stratford, E.15
Miss Joan G. Ritchie, L.D.S., 76, Stockwell Park Road, S.W.19 ;
John N. Sawley, L.D.S., 49, Newsham Drive, Liverpool, 6 ;
Edward Stuart Smith, L.D.S., 11b, Portland Place, W.1 ;
Mrs. Millicent Turner, L.D.S., 4, The Ridge, Surbiton, Surrey.

The President welcomed any visitors who were present and expressed the hope that they would take part in the discussion on Dr. Whillis's paper if they desired to do so.

THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS

INCOME AND EXPENDITURE ACCOUNT for the Year ended 30th September, 1946

1945 £	s.	d.		£	s.	d.	£	s.	d.
10	12	6	To Storage Rent	..		..	10	10	0
57	10	0	,, Repairs	..		..	–	–	–
23	1	6	,, Printing and Stationery ..	46	4	8			
–	–	–	,, Transaction 1944-45 ..	150	0	0			
137	16	1	,, Transactions 1946.. ..	150	0	0			
							346	4	8
14	10	3	,, Postage	..		..	11	5	11
18	18	0	,, Meeting Expenses ..	..		..	10	10	0
–	–	–	,, Hire of Hall	..		..	45	0	0
8	8	0	,, Reporting	..		..	31	10	0
8	13	4	,, Refreshments	..		..	29	5	9
1	2	6	,, Insurance	..		..	1	2	6
2	5	3	,, Lighting	..		..	3	16	4
2	12	3	,, Removal Expenses ..	..		..	–	–	–
30	14	11	,, Travelling Expenses ..	..		..	3	9	2
5	5	0	,, Audit and Accountancy Fees	..		..	5	5	0
2	0	6	,, Sundries	..		..	2	1	10
£323	10	1					£500	1	2

1945 £	s.	d.		£	s.	d.
225	3	6	By Members' Subscriptions	264	10	0
–	–	–	,, Sales of Transactions	8	8	0
15	19	8	,, Interest on Investment	16	6	1
82	6	11	,, Excess of Expenditure over Income for year to date	210	17	1
£323	10	1		£500	1	2

THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS

BALANCE SHEET as at 30th September, 1946

1945								
£	s.	d.		£	s.	d.	£	s. d.
			Accumulated Fund :—					
			Balance 1st October, 1945	1,706	10	0		
1,706	10	0	*Less* : Excess of Expenditure over Income for year to date	210	17	1		
							1,495	12 11
			Creditors :—					
			Transactions 1944-46 (2 volumes) (Estimated by					
120	18	7	Hon. Treas.)	300	0	0		
–	–	–	Printing	1	4	0		
–	–	–	Hire of Hall	11	5	0		
2	2	0	Subscription in advance ..	1	1	0		
4	7	6	Storage Rent	7	17	6		
							321	7 6
£1,833	18	1					£1,817	0 5

1945								
£	s.	d.		£	s.	d.	£	s. d.
			Furniture :—					
621	10	0	Balance 1st October, 1945				621	10 0
			Debtors :—					
			1946 Subscriptions received since 30th September, 1946				4	4 0
			Investments at Cost :—					
400	0	0	500 National Savings Certificates	400	0	0		
525	11	6	£691 5*s.* 10*d.* 2½% Consolidated Stock	575	14	0		
							975	14 0
			(Market Value at 30th September, 1946 was £1,450 7*s.* 8*d.*)					
283	13	0	Cash at Bank				213	1 5
			Cash in Hand :—					
			Hon. Treasurer	1	15	10		
1	3	7	Hon. Secretary	0	15	2		
							2	11 0
£1,833	18	1					£1,817	0 5

Certified in accordance with the Books and Vouchers of the Society. We have verified the Investments and Cash at Bank.

Fredk. B. Smart & Co.
Chartered Accountants.
22, Queen Street,
London, E.C.4.

13*th November*, 1946.

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